HOW TO TEACH AGRICULTURE

A BOOK OF METHOD

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AND
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HOW TO TEACH AGRICULTURE

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HOW TO TEACH AGRICULTURE

A BOOK OF METHODS IN THIS SUBJECT

BY

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223 ILLUSTRATIONS

"If vain our toil,
We ought to blame the culture, not the soil."
POPE—*Essay on Man*

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PREFACE

THE Introduction gives the reasons of the authors for preparing this book.

It is hoped that the book will be of real help to all those who are actually teaching as well as to those planning to do so and to those responsible for the supervision or administration of the teaching of agriculture. From beginning to end, it is planned as a teachers' book. It does not contain any treatment of agricultural subject matter or the facts of pure agriculture. It is intended for use in teacher training courses in colleges and normal schools, and any high schools offering such courses. It is also intended for every teacher who wishes to teach agriculture. Teachers' reading circles will find the book suited to their needs, if they wish to study the teaching of this subject.

The book is free from long lists of subjects quoted from the tables of contents of books of agriculture. Neither does it contain such lists taken from the outlines so freely published by many state boards and departments of education. For such tables and lists, the user of this book is referred to the numerous texts on the subject matter of agriculture and the various state reports and official bulletins.

Acknowledgments.—The illustrations have been furnished largely by teachers of vocational agriculture in the various states. Under the picture, usually, credit is given in each case, except those supplied by the authors.

To our own students, who have actively coöperated in supplying suggestions, materials, and the necessary inspiration for this book, we are extremely grateful. To Mrs. Fanny Waugh Davis and Mrs. Elizabeth Hayler Storm the authors join in expressing appreciation for valuable assistance in preparing the manuscript and reading proofs.

Several experts in special lines have read, criticized, and otherwise materially aided us in preparing certain chapters. Credit is due Frederick L. Griffin, of the University of California, for many valuable suggestions, and to John V. Ankeney, of the University of Minnesota, for aiding with the chapter on Charts, Slides, and Films; to Andrew Boss, of the University of Minnesota, for examining

the manuscript of the chapter on How to Teach Farm Management; to C. H. Lane, chief, Agricultural Education Service of the Federal Board for Vocational Education, for examining and criticizing the proofs.

Those who use the book are urged to write to one of the authors and give criticisms and suggestions for the further improvement of it.

A. V. Storm
Kary C. Davis

January, 1921.

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HOW TO TEACH AGRICULTURE

CHAPTER 1

INTRODUCTION

THE present forward movement in improving the methods of teaching agriculture has doubtless impressed itself upon the minds of the older teachers more than upon those who have recently entered this field of teaching. Many changes have been made in the methods of teaching agriculture in recent years, but the most rapid introduction of the new changes has been made since the passage of the Smith-Hughes Act, which took effect July 1, 1917. The most noted change made in the methods of teaching which took place about this time was the use of home project work. (See Chapter XIII.) A few states had, prior to this, been conducting the agricultural high school work on the home project basis. A number of isolated schools in other states had long been trying this method. It remained, however, for the passage of the Smith-Hughes Act of Congress to cause the widespread introduction of the home project method of teaching agriculture.

The Smith-Hughes Act.—This law makes provision for Federal aid of public schools teaching vocational agriculture to students above fourteen years of age. State Boards were to be designated by each state for governing schools availing themselves of the benefits of this Act. In most states these boards have issued printed courses of study. These pamphlets, which may be secured by all teachers of agriculture, usually contain in detail the conditions for the establishment of vocational departments or schools and the advantages of so doing.

The State Boards appoint directors of vocational education and supervisors of the training in vocational agriculture. They designate what institutions shall train teachers for the different lines of vocational education. Printed forms are issued under the authority of the State Boards and may be obtained by teachers desiring them. These forms include all or nearly all that are needed for complying with the plans for organization and administration laid down by the State Board and by the Federal Board for Vocational Education.

Need for Books on Methods of Teaching.—The authors of the present volume believe that there is a growing need for more literature on the subject of *methods of teaching* agriculture. The number of schools that have introduced vocational agriculture since the passage of the Smith-Hughes Act have, in most states, been limited to the number of teachers sufficiently qualified to instruct in the subject. Departments for the training of agriculture teachers have been established in all the states. Usually these have been in state colleges of agriculture. These training departments found it impossible at first to supply enough teachers for the schools desiring to introduce vocational agriculture.

There have been many books giving methods of teaching nearly all other school subjects, but few that have really given very definite suggestions on the subjects in agriculture. If there be justification for so many books on methods of teaching geography, mathematics, language and other school and college subjects, there certainly is some justification for issuing at least a few books which deal with real methods in teaching agriculture.

Little Attention to Methods in the Past.—All who have made a study of the past and present methods of teaching agriculture readily realize that too little attention has been given to the specific methods of teaching the different branches of the subject. It was early claimed by many that the need was not for instructors who knew how to teach, but for instructors who knew subject matter only. A knowledge of subject matter has been allowed to take the place of methods of presenting the subject to students.

Breadth of the Field of the Agriculture Teacher.—The teacher of agriculture is an organizer, an administrator, a manager, a teacher, and a community leader. It is the purpose of this book to be to him "guide, counsellor, and friend" as he endeavors to perform his duties in these several capacities. It is an attempt to put into his hands, in one volume, such guiding principles and such specific instructions for his actual tasks as will not only lay a solid foundation for correct ideals but also enable him to perform his daily work with success.

Meeting His Needs.—Sound ideals of the aims of education, a clear understanding of how society organizes and administers education and an appreciation of the place of agriculture in each is necessary if he is to perform wisely his part in the incorporation of his chosen subject, agriculture, into our system of

universal education, particularly the public schools. Chapter II endeavors to assist in attaining these ideals and this understanding.

While in conducting the daily work of the school or the class it is impossible wholly to separate managing from teaching, since the two frequently occur simultaneously, it has seemed best, in order to concentrate the attention properly upon each, to treat them in different chapters. Unless a school or class is well managed and governed, good teaching cannot be done. Good managing and controlling are not wholly matters of native ability, even though natural gifts may make them easier for some teachers than for others, but are largely the result of careful study and planning. To furnish the opportunity for this study and to aid in making and executing proper plans, Chapter III has been devoted to management in general, the management of the class, and government.

When an attempt is made to condense a truth into an epigram it usually becomes a half truth. "Teachers, like poets, are born and not made," to express the whole truth should be, Teachers are *both born and made.* To be born with capabilities which make easy the attainment of skill in teaching is a blessing vouchsafed to persons in varying degrees; to develop to the greatest possible extent all of one's aptitudes for teaching is an opportunity open to all. To make better teachers, so far as that can be done through the acquisition of better methods, is the purpose of Chapter IV.

The teacher ambitious to use the best methods has three distinct handicaps. First, in doing anything, because of the strength of the tendency to imitate, we do as we have seen done and not as we have read or heard that we should do. "As the old cock crows, the young cock learns." The tendency of young teachers is to teach as they were taught and not as they have been told to teach.

The second is that teachers of agriculture, particularly those in charge of special departments of agriculture in secondary and elementary schools, were taught their agriculture in colleges and many of the methods of teaching used therein are ill adapted to use in the public schools. The combination of these two conditions places the teacher under very heavy handicaps.

The third relates to the organization of subject matter he is to teach. In most colleges of agriculture the subject matter is taught in highly differentiated units, in great scientific detail, and frequently, with a great degree of isolation from related units. It should not be so taught in public schools. This means that the teacher, if he is to teach in the public schools, is under the necessity

of completely reorganizing his subject matter, abandoning the organization through which he received his knowledge of agriculture, and making an organization of his own adapted to the needs of his pupils.

Overcoming Handicaps.—The teacher of agriculture who hopes to render the largest service to his pupils must overcome these handicaps. There are four definite means by which he can accomplish this. He can watch good teachers teach; counsel with those who are judges of good teaching methods; read the best professional literature upon the subject; and make a careful application

Fig. 1.—Vocational agriculture is often chosen by men who were injured in the World War. These take rehabilitation work in the Junior College of Agriculture, Ontario, California. (Chas. J. Booth.)

to his own work of what he has learned and measure the results. As an essential preliminary to the successful use of these means he must first realize that he is under these handicaps. It is one of the purposes of this book to assist the teacher in overcoming such handicaps as he may possess.

In overcoming the first he must test all methods by means of which he learned, by applying the standards of pedagogical soundness, discarding such as are unsound in their pedagogy or not adapted to the conditions under which he is teaching. He should not assume that a method is sound simply because it was used with classes in which he was a student. A method should have some more substantial reason for its use than mere custom. As a

scientific agriculturalist he believes in testing the rule of thumb by the principles of science before adopting a mode of procedure. As a teacher he should pursue the same scientific process with his methods of teaching. If he does he will endeavor to find a sound pedagogical basis for his methods of teaching and management and not be satisfied with a mere blind following of the practices in use when he was a student. He will doubtless use many of them but it will be because they are sound and not because they were used when he was taught.

In overcoming the second, let the teacher adapt methods to his students. A clear discrimination between methods adapted to college students and those adapted to the particular class of students he may be teaching at the time will enable him to use proper methods. A careful and conscientious study of this text and the references contained therein, especially Chapters III to XI, inclusive, should be of much assistance in overcoming these handicaps.

In reorganizing his subject matter he will find help in the treatment of the curriculum in Chapter II and in the topics relating to content in each of the Chapters V to XII, inclusive, which deal specifically with the teaching of the different divisions of the curriculum. To supplement the matter contained in these, other chapters have been devoted to the use of land in the teaching of agriculture, Chapter XIV, the making and use of charts and slides, Chapter XV, and the special agricultural library, Chapter XVI, which will be found helpful in both management and methods.

Three other chapters, XIII on how to deal with home projects, XVII on how to conduct community work, and XVIII on how to conduct boys' and girls' club work, are intended to aid the teacher in his responsibilities as a community leader though the home projects constitute a part of his school work, and when the boys' and girls' club work becomes fully incorporated as a regular activity of the public schools, which it must do if it is to become thorough and permanent, it will be a school enterprise conducted partly at the school and partly at the home, as are the projects.

Use of the Book.—This book is intended to constitute a unit which will give to the one who uses it a preparation fairly well distributed over the different fields of activity of the teacher of agriculture. It may be studied in the order of the numbering of the chapters though that is not at all necessary. Each chapter is so sufficiently independent that any order may be followed which seems best adapted to the local situation and any chapter, the sub-

ject matter of which is not needed at that particular time, may be omitted without detracting from the value of the others.

Exercises follow each chapter. To make the thoughts clearer and to fix them more permanently, use should be made of these exercises. In doing so, the different exercises should be used in connection with the appropriate topics in the text and not left as something to be studied after the whole text of the chapter or of the entire book is finished. Not every exercise needs to be taken by every pupil nor even by every class. The exercises should be adapted to the needs of the pupils and to local conditions. If these indicate that some exercises applying to a given topic are unnecessary, such should be omitted. If there is need for more of a given kind, the teacher or the students should originate them.

The references, especially those at the foot of the page, should be consulted when possible. In Chapter IV, citations to specific books made by number at the close of each paragraph make such consultation especially easy upon the subject of methods.

For Whom Intended.—This book is intended for teachers in service who are teaching agriculture in any kind of institution, whether it be the one-room country school, the consolidated school, the town or city school, the high school, the normal school or any other institution in which agriculture is taught; for students in universities, colleges, normal schools, and other institutions who are preparing to teach agriculture; for city, county, and district superintendents, principals and supervisors and others who are responsible for the supervision of the teaching of agriculture in schools under their charge; for persons engaged in extension work, short courses, and other forms of non-curricularized agricultural teaching and advising; and for those who are preparing prospective agricultural teachers for their future work.

Result of Experience.—This book is the result of many years of experience of the authors in teaching in the public schools of both country and city, in schools and colleges of agriculture, in extension and community work, in farmers' institutes, in teachers' institutes, and especially in the college training of prospective teachers of agriculture. A careful study has been made of the needs of those for whom it is intended and a serious effort has been put forth to adapt it to their requirements. In publishing it, if they can contribute to making more effective the teaching of those who use it and to improving the education in agriculture which the next generation shall obtain, the authors will feel compensated.

CHAPTER II

HOW TO ORGANIZE FOR TEACHING AGRICULTURE

THE CURRICULUM

THE curriculum should provide for many forms of doing, on the theory that the highest forms of culture are as dependent upon doing as upon knowing.

The curriculum must contain problems whose solutions are worth seeking if the problem method of teaching is to be utilized to its best advantage. Agriculture, as a subject of study, lends itself very readily to the problem system of organizing a curriculum. The *real* makes to most minds a more valuable as well as a more tangible and interesting problem for solution than does the fictional or the unreal.

The non-vocational agriculture curriculum should contain those materials regarding science and agriculture which should constitute the common knowledge of every well-educated citizen of a nation like ours whose greatest and most fundamental industry is farming.

The pre-vocational agriculture curriculum should provide for an acquaintance with the world of nature, with manual labor, and with the field of science; furnish the experience essential to the wise choice of an occupation; and give the beginnings of a preparation for farming should the pupil choose that vocation.

The vocational agriculture course should provide such a knowledge of scientific and practical processes and such a skill in their application as will enable the student to obtain both profit and pleasure from the occupation of farming.

Content.—Regardless of what methods you may use or whether or not you use a textbook or bulletins or other helps, the agriculture curriculum of the rural school, the grades of the town school and the vocational agriculture of the high *school should be based upon the actual agricultural operations of your locality* (Figs. 2–5). No other plan will enable you to obtain the full and rich values and fulfil the important aims of the teaching of agriculture. Obtain courses of study and syllabi and outlines from all possible sources but reject in them everything that cannot be made to contribute to a practical and scientific knowledge of the agriculture of your own locality. Examine the laws of your state, the rules of your

Fig. 2.

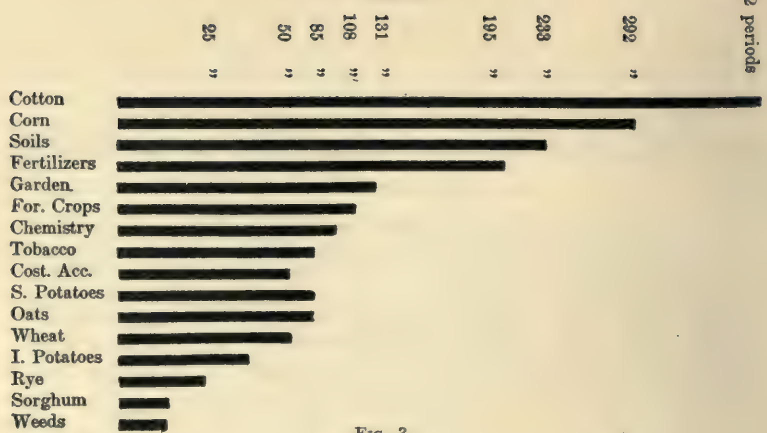
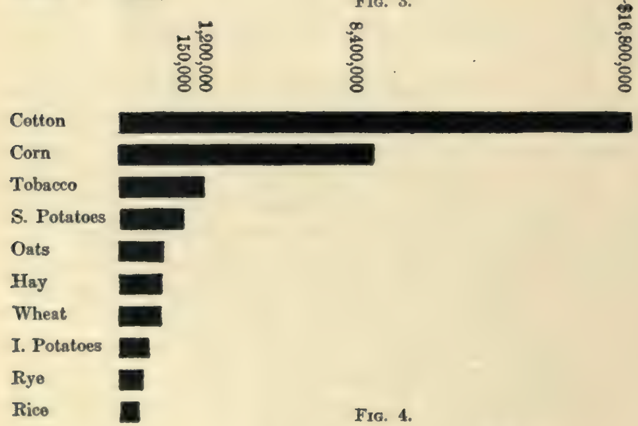


Fig. 3.



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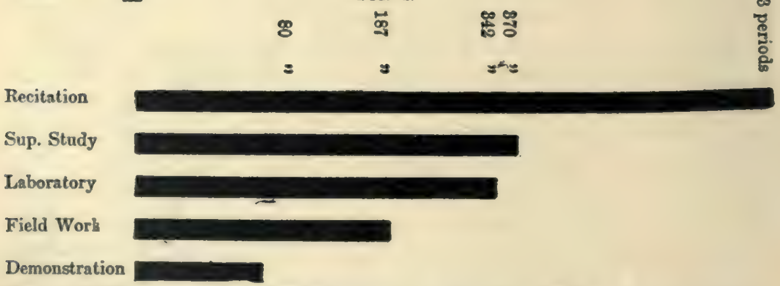

Fig. 2.—Relative amount of class time devoted to the various field crops by vocational schools in South Carolina.

Fig. 3.—Relative values of field crops in South Carolina.

Fig. 4.—How the time of vocational students is divided in the South Carolina agricultural schools. (South Carolina State Supervisor's Report).

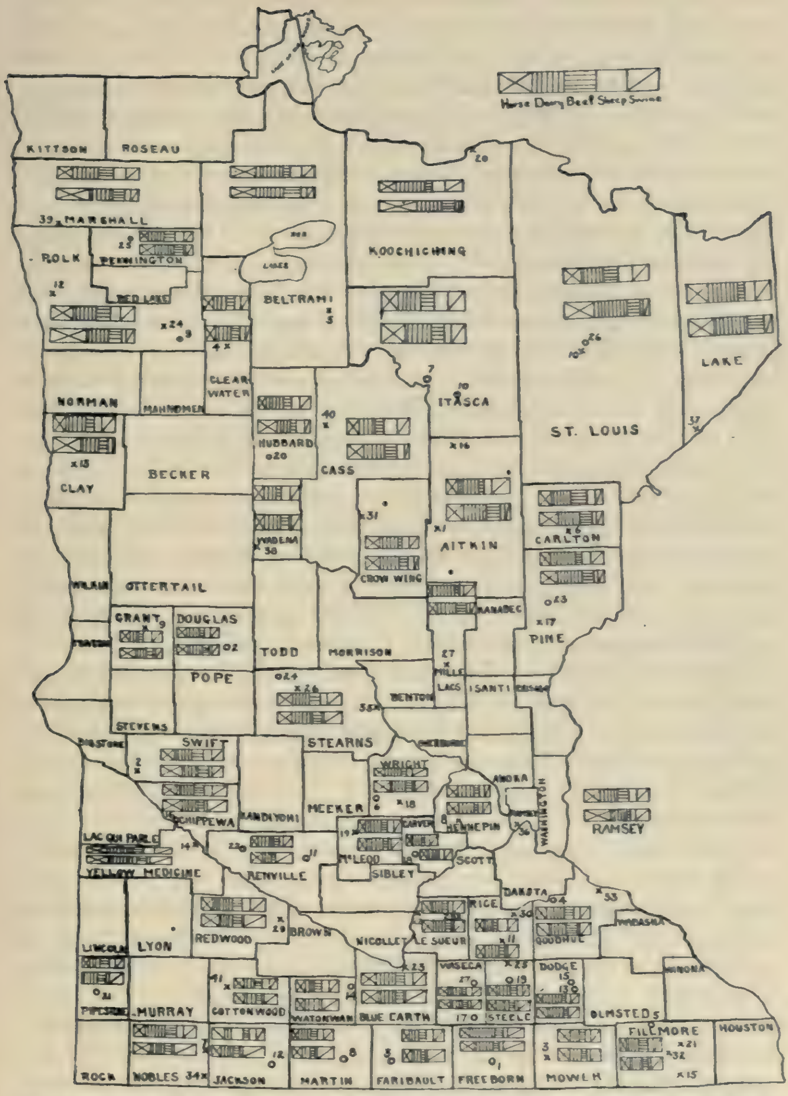

FIG. 5.—Graphs showing the amount of time devoted to each class of stock, by the high schools of one state, as compared with the value of the stock in the county. Upper bar is the time. Lower bar is the valuation. (Study by Sherman Dickinson.)

state department of education, your state and county board of education and local board so far as they apply to the curriculum and particularly to the agricultural curriculum. If any of these or other authorities have arranged courses of study or outlines in agriculture, obtain them. Obtain curricula and exercises from the United States Bureau of Education, U. S. Department of Agriculture, and U. S. Federal Board for Vocational Education, all of Washington, D. C., and from your state college of agriculture and the college or department of education of your State University. In many of the states the normal schools have rendered valuable service by preparing curricula in agriculture suitable for the rural schools and for the elementary grades of the town schools. If such courses have been prepared by the normal schools of your state or those in your region it will be well to obtain them for assistance in organizing your curriculum. If these can be made to apply to your local agriculture, use them, rejecting such portions as do not. If no applicable and adequate curriculum is obtainable, develop one yourself with the approval of the proper administrative officers, utilizing such assistance from the sources mentioned above and from books, pamphlets, and other references as are of value. Remember that only by basing your selection of curriculum material largely upon its applicability to the type of local farming can the greatest values be obtained from teaching vocational agriculture.

As a standard for guidance each teacher, whether in rural school, grade or town school, or high school, should have the curriculum prepared by the Committee on Agriculture of the National Education Association Commission on Reorganization of Secondary Education, which is published by the U. S. Bureau of Education. The arrangement of this curriculum is briefly as follows:

Agronomy, one year; animal husbandry, including dairying and poultry, one year; horticulture, soils, farm engineering, and farm management, one-half year each. This sequence and time allotment are for the schools in the regions of diversified farming and should be changed to be adapted to any special type of farming or modified to meet the needs of schools unable to spend that amount of time upon agriculture. In making such modifications, attention should be given to the type of local agriculture, the natural interests of pupils, the pedagogical sequence of the subjects, correlations with other portions of the curriculum and the relative administrative adaptability of the subjects to the conditions at the school, and, if necessary, to the teacher's preparation on the

different topics. Essential adjuncts to the curriculum are the home project and the extension work, which are also treated in the report of the committee.

Special Organization in the Rural School.—In the rural school where pupils are few, classes many, recitation periods short, the teacher's knowledge of agriculture not that of an expert, and therefore special preparation of each agricultural lesson almost a necessity and the teacher's time for preparing a lesson brief, the best plan of organization is to have only one class in agriculture in any one term. The members of this should be the pupils of the eighth grade, the seventh grade, the sixth grade and such other pupils as because of nationality or special interest should be allowed to pursue the study.

Three-year Rotation for Rural Schools.—The curriculum should then be distributed over three years, one year of which is taught each school year. For example, suppose it were decided to include in one year of the curriculum the study of the crops of the field, garden, and orchard; in another year, the animals of the farm—horses, cattle, hogs, sheep, poultry, including the various animal products such as milk, butter, cheese and eggs; and in a third year the mechanical work on a farm, planning, arranging and beautifying the farm and farm home, simple farm records and accounts, good roads, community needs and improvements, and similar topics. During the school year 1920–1921, the pupils in grades 6, 7, and 8 would study the agriculture of the crop year of the curriculum; during the school year 1921–1922, the pupils who were that year in grades 6, 7, and 8 would study the agriculture of the animal year of the curriculum; and during the school year 1922–1923, the pupils who were that year in grades 6, 7, and 8 would study the other year of the agriculture curriculum. Then in the school year 1923–1924, the crop year would be studied again, the other two years following in succession. Through this plan each pupil (when the plan is fully in operation) would obtain three years' instruction in agriculture, but the teacher would have only one class in agriculture in any one year, and would prepare herself for only one-third of the curriculum during any one year.

When such a plan is in operation in a county or a state, all the forces, including public interest, are concentrated upon the special work for that year, and the results are greatly improved thereby.

The above distribution of topics within each of the three years is not essential. Some of the crops, some of the animals, and some of the mechanics, and farm and community improvement topics

may be put in each of the three years, and the plan be administered equally well.

Special Organization in the Grades of the Town School.—Since pupils in the town schools, due to greater regularity of attendance, are, on the average, younger in the same grade, it is better to confine the agriculture work here to the two upper grades, the curriculum being two years instead of three years in length. If classes are small the pupils of the two grades may be united and half of the curriculum taught to them each alternate year of school, thereby saving time and labor for the teacher. If classes are of normal size or larger, both years of the curriculum can be taught each school year, one to the seventh grade and one to the eighth.

FIG. 6.—Appropriate styles of working garments worn by boys in agriculture and girls in domestic science. (G. S. Boggan, Ark.)

In a school where there is but one seventh grade class and one eighth grade class, and only the boys take agriculture (the girls taking home economics or some other study at the same hour), combining the boys of both grades into one class is better administration (Fig. 6).

Special Organization in the High School.—Since high school agriculture is a subject requiring frequent laboratory work and since high school administration is organized on the basis of double periods for laboratory work, it is impossible for one teacher of agriculture to teach the entire four years of the agriculture curriculum during the same year and perform the other duties necessarily connected with agricultural teaching. If the number of pupils studying agriculture is great enough to require four classes, an additional teacher of agriculture should be employed.

If the agronomy course is to be taught every year and the animal husbandry course every year, and the remaining courses each once in two years, by combining all the agricultural students of the highest two years into one class, one teacher can conduct the classes if he does not teach other classes in the grades or special groups such as the teachers' training classes in the high school.

If the number of pupils in the high school agriculture classes is small enough to permit it, the agronomy course can be taught to the combined freshman and sophomore classes one year and the animal husbandry course taught the next year to the combined

FIG. 7.—Young women as well as young men may pursue projects in apple growing. Here they are having their first practice in a neighbor's orchard.

freshman and sophomore classes of that year. In like manner the juniors and seniors may be combined into one class in agriculture each year, one year studying soils and horticulture and the next farm mechanics and farm management. With this arrangement the teacher of agriculture will be able to teach some agriculture in the grades below the high school and also one special class, if the number of such recitations be not too great, and still have some time for community work.

All of the above arrangements provide for the high school pupil obtaining four years of agriculture work in the high school without so overloading the teacher as to prevent his attending to his other essential duties as an agriculture specialist.

Supervising Agriculture in Nearby Schools.—If, as in Minnesota under the statute for associated schools, the special teacher is expected to conduct work in the nearby one-teacher rural schools, the organization of his work in the central school must provide time for this to be done without encroaching upon his other class work or his community duties.

Where there are several such rural schools associated with the same central town school, this becomes an important feature of his work. In such a system probably the best procedure is for the special teacher of agriculture to lay out the curriculum, assemble the rural teachers at a central point and prepare them for teaching it and then let them teach it to their pupils under his supervision. This supervision may be by regular (perhaps weekly) visits, and occasional reviews and quizzes.

Fig. 8.—The dairy and soils classes make use of the chemical laboratory. (W. P. Dyer.)

Emphasis on Farm Practices.—Vocational agriculture must have as one of its definite purposes the attainment of the best farm practices. Whether in high school, grades, or rural school, *what to do and how best to do it* accompanied by such a knowledge of scientific principles as makes possible rational procedure whether sets of conditions are identical or merely similar, should be a dominating ideal in the choice of the curriculum and in the methods and organization and administration of the agricultural work of the school. The content of the curriculum should be chosen with that end plainly in view and any organization or administrative difficulties that arise should be caused to give way, so far as possible, to the accomplishment of that aim (Fig. 7).

Correlations of the Curriculum.—Not only should the parts of the agricultural curriculum articulate properly with each other, but the agriculture should correlate effectively with the other

studies of the general curriculum. The thoughtful teacher will find many opportunities to correlate the agriculture work with language, arithmetic, and geography as well as the work of the season at the homes and on the farms. In the high school, special effort should be made to correlate the work of the sciences with the agriculture in order that the former may prepare for the latter and the latter give point and purpose to the former. Botany should prepare for crop studies; zoölogy for the animals and the animal pests of crops; physics and chemistry for farm engineering and soils; and general science for all. Such correlations offer some administrative difficulties but every effort should be made to establish them. The science teachers and the agriculture teacher should coöperate to the greatest possible extent to further this coördination (Fig. 8).

THE CLASS

Assigning the Pupil to His Group.—The one general basis of determining to what class or group an individual pupil shall be assigned is the relative values to that pupil at that time of the work of the different portions of the curriculum. This will depend upon two main conditions: his ability to comprehend the subject matter and its serviceability if comprehended. In the lower grades where a knowledge of the content of one grade is necessary to do the work of the next grade, passing successively through the grades in regular order will usually be required. In the upper grades (seventh to twelfth approximately) such rigidity is not necessary and wisely guarded choices may be allowed, limited only by the two conditions just named.

His ability to comprehend will depend upon his age, native ability, home surroundings and health. The value of the curriculum content to him (above the lower grades) will depend upon the plans for his future schooling and life work and those general aims of advanced education mentioned at the beginning of this chapter (Fig. 9).

Classification Not Difficult in Agriculture.—The teacher of agriculture will have little difficulty in classifying a pupil in that subject. His general classification will have been determined previously by the administrative regulations of the school. For agriculture but two questions will have to be answered: Is he capable of successfully comprehending the subject? Is it of sufficient value to him at this time?

While it is desirable to have the members of an agriculture class of about the same age, capability and attainment, it is quite possible for a keen twelve-year-old boy of the sixth grade to do as

FIG. 9.—Pupils of third and fourth grade may have practice in knotting and splicing of ropes. (Lewiston, Minn., Schools.)

FIG. 10.—The normal students in high school need to have practice in corn scoring. (Shakopee, Minn., High School.)

good work in the rural school agriculture class as a less keen sixteen-year-old boy of the eighth grade. In the one-room rural school there should be one agriculture class, as explained under "curriculum" and this should contain the boys and girls of the seventh and eighth grades, or at least, such as desire to take it, and similar

pupils from the sixth grade who desire it and are capable of comprehending it properly. In the high school when the subject is first introduced, any pupil who desires to take it in the class in which it is offered or *in any class above* should be admitted, subject only to the number limit of pupils of the class and to program conflicts. Even when the curriculum is fully established, any student classified above a certain agricultural subject should be allowed to enter the class and in exceptional cases, for sufficient reasons, a pupil classified below might be allowed to enter also. In the high school the greatest freedom should be allowed in vocational studies limited by proper guidance. (Fig. 10). Pupils of different general classification may succeed equally well in such a vocational subject as agriculture.

FIG. 11.—Even the local livery stable is sometimes visited by classes in animal husbandry. (J. A. Wisdom.)

DAILY PROGRAM OR SCHEDULE OF RECITATIONS

Necessity.—To direct and conserve the time and efforts of the teacher and the pupils, a definite, systematically arranged program of recitation is essential to the efficiency of every school. The program of each day need not necessarily be identical with that of every other day, nor the program be like that of another school, nor is it necessary that the program provided for a certain day be held absolutely immutable if sufficient cause arises to warrant a change. But a time and place should be provided for each exercise of every day.

Agriculture in the Program.—In the crowded rural school many plans may be used to find time in the program for agriculture. If substituted for a part of the language lessons there will be no loss, for it will furnish the content for many of the most valuable

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lessons. Likewise in the reading the study and silent reading of agricultural literature specifically related to the work being done in agriculture will be of greater value than many formal reading

FIG. 12.—The normal training class must be given practice work so they can make their teaching thorough. Digging potatoes. (Bemidji, Minn., Schools.)

FIG. 13.—Banquet prepared by short-course girls for short-course class in agriculture. (L. A. Henke, Minn.)

lessons because of being more purposeful. By alternating with geography or history and (since three classes are combined) by increasing the length of the recitation beyond the average enough work can be done to cover a good curriculum. The vital relation-

ship of the subject matter to the life of the community and the vitalizing effect of the other studies ought to make its inclusion in the program a real economy of time.

Placing it in the program of the seventh and eighth grades of the town school is a much simpler task, as two or three recitations a week of agriculture can be easily substituted for some of the more formal and less valuable parts of the other studies there. If home economics is provided for the girls of these grades and either or both the agriculture and home economics taught by a special teacher, one or both sets of pupils can go to the rooms of the special subject to recite at the same period.

In the high school the program is more difficult to arrange. To make a four-year curriculum available to the student; to have double laboratory periods available for each class every day (Fig. 11); to teach some agriculture in the seventh and eighth grades; to teach the normal teacher training class of prospective rural teachers (Fig. 12); and yet find time for conducting home projects, community activities, short courses (Fig. 13), a school plot of ground, and home gardens of pupils, and supervise work in nearby rural schools with one agricultural instructor requires a well-arranged program for the week.

Let us see some of the possibilities. Suppose the freshman class is studying agronomy, the sophomore animal husbandry, the eighth grade two recitations per week and the normal class three per week; his arrangement could be as follows:

	Monday	Tuesday	Wednesday	Thursday	Friday
First period	Animal husbandry	Animal husbandry	Animal husbandry	Animal husbandry	Animal husbandry
Second period	Animal husbandry	Animal husbandry	Animal husbandry	Animal husbandry	Animal husbandry
Third period	Agronomy	Agronomy	Agronomy	Agronomy	Agronomy
Fourth period	Agronomy	Agronomy	Agronomy	Agronomy	Agronomy
Fifth period	Normal class	Eighth grade	Normal class	Eighth grade	Normal class
Sixth period	....	....	....	....	....
Seventh period	....	....	....	....	....
Eighth grade	....	....	....	....	....

This would leave him most of the afternoon for projects, community service, rural schools, gardens, school plot, and preparation.

Any day when a high school class needed a double period for laboratory work it could be available by extending the work into the second of the two periods provided.

A more condensed program is possible under the following plan:

	Monday	Tuesday	Wednesday	Thursday	Friday
First period....	Animal husbandry	Animal husbandry	Animal husbandry	Animal husbandry	Animal husbandry
Second period....	....	....	....	....	....
Third period.....	Agronomy	Agronomy	Agronomy	Agronomy	Agronomy
Fourth period...	Normal class	Eighth grade	Normal class	Eighth grade	Normal class
Fifth period.....	....	....	....	....	....
Sixth period.....	....	....	....	....	....
Seventh period...	....	....	....	....	....

This would give him afternoons entirely free from class-room work and would allow him to use the second period for laboratory work in animal husbandry (Fig. 11) or agronomy on any day but not for both on the same day. This is only possible in case the animal husbandry students have no other recitation the first and second periods and the agronomy students none the second and third periods. The possibilities of program arrangements under different conditions can be further shown by working out the exercises at the close of this chapter

THE TEXTBOOK

Scoring Textbooks.—To properly evaluate the various texts in a subject and to reach a sound conclusion regarding their relative values and their adaptability to a given set of conditions a score card is of great assistance. The following score card was originated by the faculty of the Division of Agricultural Education of the University of Minnesota and has been used for several years by the students taking courses in that department. Every student preparing to teach agriculture is required to judge by aid of this score card several books in each of the branches of agriculture, agronomy, animal husbandry, soils, horticulture, farm management and farm engineering; and also books for the grade agriculture and country schools and for the normal training class in which are prepared the country teachers. Each student thus begins his work as a teacher with a carefully developed judgment of the relative merits of the various books from which he may be required to select those to be used in his classes.

Choosing by the Aid of the Score Card.—The general plan of the score card is to assign to each desirable characteristic that a textbook ought to possess a certain numerical value, the total of

which value equals 100. The values assigned to the separate characteristics on the score card are supposed to represent the relative importance of the different characteristics on the basis of their total being 100. For example; "adaptability" is of much more value than "binding."

The general procedure in selecting a book by aid of the score card is:

First.—Obtain copies of such books as by information or cursory examination seem to be adapted to the purpose for which the chosen book is to be used.

Second.—Familiarize yourself with the general plan of the score card and with the meaning and scope and value of each item of it.

Third.—Record the score of the different books for each item.

Fourth.—Add the values assigned to a book to obtain the total score for that book.

Fifth.—Rank the books according to the total score of each, assigning first rank to the book whose score is nearest 100.

Sixth.—Examine the books without the aid of the score card and see if your "general judgment" regarding their several ranks agrees with that obtained by the score card.

Seventh.—Examine your score card and the books for errors in figures or judgment, correcting until score card and general judgment agree.

Explanation of the Score Card and its Use.—*Content.*—This signifies the subject matter which the book contains and is somewhat independent of its specific *teaching* qualities although a book lacking in the characteristics scored herein would be, of necessity, a poor book to use in teaching.

Adaptability.—Ask such questions as: Is it too difficult or too easy for the class of pupils for whom a book is being chosen (*e.g.*, high school seniors, juniors, sophomores, or freshmen, eighth grade, rural school, prospective rural teachers)? Is it adapted to the type of local agriculture? Does it cover the field desired? Does it follow properly preceding texts used by this class?

Proportion.—Make careful comparisons of the quantity distribution of the various topics. Within the field desired is the content distributed in proper relative quantities over the various topics considered? Are some treated too fully (relatively) or too briefly or omitted?

Laboratory Exercises.—Are there any? Do they properly clarify or reënforce the text material? Are they adapted to the laboratory facilities that can be made available to this class? Are there questions on experience? Are there suggestions for home exercises, readings and observations?

References.—Are there any? Do they refer to authorities for statements made? Are references suggested for further reading? Are they to specific pages or chapters or to titles only? Are they placed in the body of the text, at the close of the topic, at the foot of the page, at the end of the chapter or at the end of the book?

Score Card for Agriculture Textbooks

(Modified from the original developed by the Division of Agricultural Education, University of Minnesota)

NOTE 1.—A book must be scored on the basis of its fitness for the particular class, school and locality in which it is to be used. NOTE 2.—Use back of sheet for explanations and remarks. Qualities or characteristics upon which book is to be scored.	Perfect score	Titles and authors of books (One column for each book)									
CONTENT:	(45)										
Adaptability	18										
Proportion	12										
Laboratory Exercises	5										
References	4										
Index	3										
Accuracy	3										
PEDAGOGICAL CHARACTER:	(40)										
Sequence	10										
Correlations	10										
Clearness	10										
Vocabulary	5										
Illustrations	5										
MECHANICAL CONSTRUCTION:	(15)										
Type	5										
Cuts	3										
Headings and paragraphs	3										
Paper	2										
Binding	1										
Size	1										
Total score	(100)										
Rank of each book											

Index.—Has it a general table of contents? Is it sufficiently full? Has it an alphabetically arranged analytic index? Is it complete? Well arranged?

Accuracy.—Are its statements true? Are its figures correct, recent, and based upon the best authority? Does it give specific or only general statements? Are values given accurately or only approximately? Is its analytic alphabetic index accurate?

Pedagogical Character.—A good text must contain not only good material as shown by the content score but it must have that material in proper form and arrangement for teaching. It is not enough to know that it contains valuable information of the kind needed by the pupils but is the material so arranged and expressed as to make learning economical and effective? Is it "teachable"?

Sequence.—Are the chapters, topics and paragraphs arranged in the best teaching order? Do the earlier prepare for the later? Do the later utilize effectively and economically the teachings of the earlier? Is the general sequence that which you prefer to follow in your school? Does the sequence conform sufficiently to the seasonal activities of the local agriculture? To the time the pupils will be studying agriculture in the school? To seasonal opportunities for home projects or other practical applications? To the best pedagogical procedure?

Correlations.—Are the different chapters, topics, and paragraphs made to reënforce each other effectively and economically? Are cross references so used that in teaching the sequence could be different from that of the numbering of the pages without destroying the value of the correlations? Are fundamentals (*e.g.*, Mendelism) which are needed in several places explained only once and then referred to whenever wanted?

Clearness.—In general is the expression clear? Are explanations clean-cut and convincing? Are sentences definite and their meaning unmistakable? Will pupils obtain from the text a correct and explicit understanding of the subject?

Vocabulary.—Are the words properly chosen? Are the best terms of scientific and practical agriculture used and in their accepted significance? Are the words comprehensible by the class of pupils for whom the book is being chosen?

Illustrations.—Are the verbal illustrations apt? Are they convincingly expressed? Are the pictorial and diagrammatic illustrations pedagogical, that is, do they *teach?* Do they illuminate the language of the text? If from photographs, were they composed for the most instructive results? Do the essential points stand out? Do they show proper proportion? Are illustrations sufficient in number? Are they sufficiently explained or described?

Mechanical Construction.—Did the printer and the binder so perform their work as to make the book adapted to the use of the class of pupils for whom a selection is being made?

Type.—Is the type neither too large nor too small? Are the letters free from extra and unnecessary lines? Is a page of it restful or irritating to the eyes? Are the lines of print far enough apart?

Cuts.—Are the cuts mechanically well made with the kind of screen best adapted to the paper used? Are they clearly defined? Is the press work good? Are cuts large enough? Well placed on the page? Well placed in relation to the subject matter which they are intended to illustrate?

Headings and Paragraphs.—Are they in proper type? Are they arranged to show the relationship of the topics? Do they guide the eye quickly to the material desired? Do they aid in a grasp of the content?

Paper.—Is the paper sufficiently thin and tough? Is it sufficiently dark and sufficiently dull of finish to be comfortable for the eyes? Is it sufficiently firm and opaque to prevent any impression from the opposite page showing through? Does it permit a clear-cut impression of type and cuts?

Binding.—Is the binding strong enough? Is it sufficiently flexible? Are the materials, colors, and style adapted to the prospective use? Will it wear long enough?

Size.—For the pupils for whom intended is the book the right length, breadth, and thickness? Is it adapted to being carried and stored with other textbooks? Is it adapted to the desks used? Could its size be improved by the use of different paper or margins without interfering with its content or pedagogical values? Would it be worth omitting some of the less important parts of the content to reduce the size?

Total Score.—There are two systems of recording the score values, and finding the total score. In one the book is credited with the amount of the desirable characteristic which it possesses and these amounts are added to obtain the final score of the book. In the other the book is debited with the amount the scorer decides should be taken off, or "cut," because of its not possessing a proper amount of that characteristic; these "cuts" are then totaled and their sum taken from 100, which gives the final score for that book. The crediting system is preferred by most persons.

Rank.—After the final scores are found the books may be ranked, the one whose score is nearest 100 being ranked one.

In General.—When scoring several books it is better to score all of them upon "adaptability," then all upon "proportion" and so on through the score card than it is to score each book through the entire score card separately. By this plan all the books are scored upon one quality while the judgment of the scorer is concentrated upon that quality and upon all the books in respect to that quality. This is likely to result in a sounder score.

If the book is so defective in some important particular that, regardless of its possessing other valuable features you would not want to use it at all, it should be marked low enough upon that point to cause its rejection.

EXERCISES

1. Discuss the adaptability to your school of the curriculum recommended by the N. E. A. Committee on Agriculture (U. S. Bu. Ed. Bulletin) and recommend improvements.

2. Arrange the various main topics of agriculture in a "three-year rotation" as proposed in the text for a one-teacher rural school giving due emphasis to the type of local agriculture.

3. Arrange the sciences of your high school curriculum and the principal topics of each science in the order in which you would like to have them presented in order to furnish the pupils the best preparation for their agriculture.

4. Enumerate a few ways in which the grade and rural agriculture can be made to correlate with the other subjects of the curriculum.

5. Several farm girls want to join the class in agronomy; would you approve their doing so? The animal husbandry class? The horticulture class? Give reasons for your decision.

6. A senior wishes to take agronomy with the freshmen; would you approve? Why?

7. Examine the daily programs of recitation of several rural schools near you and see how they could be so arranged as to provide for a recitation in agriculture twice a week; three times a week; five times a week.

8. Examine the programs of the seventh and eighth grade classes in your town schools and see how they can be adapted to the following:

(*a*) Combining the boys of the seventh and eighth grades in an agriculture class while the girls of these grades take sewing in the seventh grade room; (*b*) teaching the boys of grade eight agriculture in the high school agriculture rooms twice a week; (*c*) teaching the eighth grade boys agriculture three times

a week in their room and the seventh grade boys agriculture twice a week in your agriculture rooms.

9. If a junior high school program is available, see how it can be adjusted so students desiring it can obtain two years' work in agriculture and take as large as possible an amount and variety of other prevocational subjects.

10. If a normal training class program is available, see how it can be arranged to permit the entire class to receive instruction from the agriculture teacher under each of the following conditions: (*a*) five lessons a week during 9 weeks of the fall and 9 weeks of the spring; (*b*) three lessons a week during the first half of the year; (*c*) two lessons a week throughout the year; (*d*) combined with the regular agronomy class in the high school.

11. How can the program be arranged to meet *a*, *b*, *c*, and *d*, conditions in exercise *10*, if the agriculture is to be taught by the normal training teacher, herself?

12. Make a week's program for the special teacher of agriculture in a four year high school under the following sets of conditions in a system of schools containing twelve grades in town and some associated rural schools:

(*a*) Freshmen, agronomy, daily; sophomores, animal husbandry, and juniors and seniors, farm management, daily.

(*b*) Freshmen and sophomores, agronomy; juniors and seniors, farm mechanics; eighth grade; all classes daily.

(*c*) Freshmen, agronomy, daily; sophomores and juniors, animal husbandry, daily; seniors, farm management three days per week.

(*d*) Three rural schools five days per week supervised by agriculture teacher one day per week, each.

13. Make other programs for other conditions known to exist near you or that you hypothetically create.

14. How does your program compare with those in this chapter?

15. Each student score unaided and without conferring with other persons, two to four textbooks from which a selection is to be made for a class in your locality in (*a*) agronomy; (*b*) a class in animal husbandry; (*c*) in soils; (*d*) in horticulture; (*e*) in farm management; (*f*) in farm mechanics.

16. In like manner, score five books adapted to rural classes in agriculture and five adapted to the normal training class.

17. Students compare their scores and each defend his score, in class.

18. Judge comparatively other books of the same classes, without scoring and justify orally or in writing the placings.

19. Select from all books studied those you would prefer as class texts in the types of schools in which you are teaching or expect to teach.

REFERENCES

Bobbitt, Franklin: "The Curriculum."

Carney, Mabel: "Country Life and the Country School."

Colvin, Stephen Sheldon: "An Introduction to High School Teaching."

Hollister, Horace E.: "High School and Class Management."

Hummell, W. G., and Bertha R.: "Materials and Methods in High School Agriculture."

Inglis, Alexander: "Principles of Secondary Education."

Lane, Charles H.: "Correlating Agriculture with Public School Subjects."

Monroe, Paul: "Principles of Secondary Education."

Nolan, Aretas W.: "The Teaching of Agriculture."

Strayer, George D., and Norsworthy, Naomi: "How to Teach."

Twiss, George R.: "Science Teaching."

CHAPTER III

HOW TO MANAGE THE TEACHING OF AGRICULTURE

Agriculture Teacher as Manager.—While the superintendent, the principal, the parents and the pupils may participate to some degree in formulating or in executing the plans for management, the teacher is the most important factor in their success. The superintendent or principal may, with the counsel and advice of his teachers, determine the main features of the policy and formulate the general plans for their maintenance, but upon the teacher rests the responsibility for developing the more detailed plans and for the efficient execution of both. In the degree to which the duties of the teacher of agriculture correspond with those of the other teachers, his responsibilities are identical with theirs. In so far as they differ from those of others he must develop plans of his own and be resposibile for their proper execution. Even in these, the fundamental principles governing his relationship to others in authority are not changed.

If the teacher of agriculture is the teacher of a one-room country school she is largely a law unto herself in management, subject only to the statutes, the rules of local, county, and state boards of education, and general plans made by the county or district superintendent, and the additional plans of any supervisors working under his direction. When stated these subjections look formidable but in actual operation they usually occupy the field of administration and encroach little upon management. The rural teacher, however, will do well to consult fully and freely with her superintendent and supervisors, since they are usually persons of large experience and superior judgment.

If the teacher of agriculture is in charge of a special department of work in a town or city system, there are a few outstanding features of his responsibilities that he should see clearly and always observe carefully in his practice. Among these are the following:

That there can be but one executive head in a system of schools; that the superintendent is by custom and law that head; that no principal of a school, head of a department, or teacher is expected to divide this headship with him (duumvirates and triumvirates were long ago demonstrated to be failures in administration); that

the superintendent is the person chosen by the board to bring to their attention all matters relating to the schools upon which they should be informed and to execute within the schools all their decisions which they have a legal and moral right to make; that loyalty to the properly exercised authority of the superintendent is expected of every teacher (subject to the dictates of his conscience regarding points involving moral principles); that teachers should express their opinions freely, fully, and forcefully upon any proposed procedure, but a course of action honestly decided upon by the proper authority should be supported wholeheartedly and faithfully; that upon invitation of the superintendent the teacher should be ready at any time to present to the board any technical matters, but at no time should the teacher attempt to take to the board or members thereof by "short circuit" any official business nor encourage members of the board to bring official business to the teacher without first presenting it to the superintendent and obtaining his approval of the procedure.

Nothing should prevent the freest conference and discussion between the teachers and members of the board upon educational matters of common interest, but contemplated official action should pass through the office of the superintendent.

If there be a principal of the high school the teacher of agriculture should find out early what administrative or managerial responsibilities have been reposed in him and should thereafter conform to the plans of the school in enabling the principal to bear these responsibilities. These may include the making of the daily program of recitation and study, the general behavior of pupils, the movement of classes, the compiling of records and reports, and in the larger schools may extend to the making of curricula, the recommending of textbooks and the classifying and promoting of pupils.

For whatever features of management the principal has been made responsible the teacher should exercise full and hearty loyalty in aiding him to execute. "Render unto Cæsar the things that are Cæsar's." No factor contributes more to the success of a teacher's class management than the general management of a wise, strong, high school principal. The more loyally a teacher supports such general management the more he lightens his own burdens. Make your best knowledge and counsel available to him; execute his plans regarding the program of recitations, passing of classes, making of records and reports, attendance and general

deportment of pupils, with tact and sincerity and promptness and it shall be bread cast upon the waters.

Relationship to Co-workers.—The teacher of agriculture should maintain the most cordial relations with his co-workers. Helpful correlations of work can be established especially with the teachers of science, English, geography, manual training and home economics by means of which the work in all these departments as well as in his own may be greatly improved. His vital contact with the community, his apparent freedom of action and frequently his greater compensation should not be allowed to cause their feelings to degenerate to jealousy but should be utilized to arouse in them the spirit of emulation. He may be able to aid them in discovering means of more vital contact of their subjects with community life from which many of the other conditions would follow as results.

Professional Attitude.—To dispel a widespread belief, less warranted by the facts now than several years ago, regarding his lack of professional preparation, he should pay strict attention to his professional duties and responsibilities regardless of the heavy demands made upon his time by the practical character of his work. He should not let his fellow teachers exceed him in zeal for professional improvement nor in attendance upon gatherings for this purpose nor in participation in the proceedings.

Relationship to State Supervisor of Agriculture.—If there be a state supervisor of agriculture work the teacher of agriculture should promptly familiarize himself with the supervisor's plans, solicit his assistance and keep him informed in a modest, business-like way of what is being done. He should attend all conferences called by the supervisor when possible and participate generously in the improvement of the work in the state. He should respond promptly, fully, and accurately to all requests made by the supervisor for information.

Relationship to Community.—To the people of the community the teacher of agriculture bears a peculiar relation in that besides being a teacher in their schools he is considered to be an expert advisor regarding their business. Farmers, business, professional, and non-professional men and women of the community call upon him for advice. This gives him a wonderful opportunity to co-ordinate home and shop and store and office and farm and school, which are more fully treated in a later chapter. Here it may be said that he should take advantage of this opportunity to the

fullest extent possible without distracting from the effectiveness of his work in the school, where his first responsibility lies. He should pay special attention to the former students of the school agriculture classes, for through them he ought to develop centers of leadership for rural improvement.

Responsibility to Local Press.—Few teachers of agriculture appreciate their responsibility to the press and through it to the people. The press, especially the "country press," is recently becoming aroused to its responsibility regarding agriculture and country life. A wide-awake "country" editor would prefer an item about farmer Jones having erected a silo or Smith having produced a record-breaking dairy cow or Brown having utilized

FIG. 14.—These high school girls are taking a course in agriculture to prepare themselves for more successful work as teachers in the rural schools. (A. Z. Arehart.)

successfully a certain treatment for potato scab or the report of the annual picnic of the Lake Pokegema Farmers' Club, or the results of the seed-corn tests made by the high school class in agriculture, a warning to farmers about the quality of their seed for the coming year than the news that Mrs. De Sanford spent the week-end with her sister in Podunk or that Mrs. Oriole had bought a new piano from Stringem and Pound. But the editor is not ubiquitous. The teacher of agriculture and his pupils can render the community great service by furnishing through the local paper matter of greatest value to them at that time. (Chapter XVIII).

Teacher of Agriculture under Supervision.—The teacher of agriculture may play a double rôle in the field of supervision. The superintendent or principal who is responsible for the success of the management and teaching in his schools ought to have personal

knowledge of the success of the teacher of agriculture in these regards. To obtain this he should make personal visits to observe the work. The teacher of agriculture should welcome these visits and also the criticisms and suggestions arising from them. The superintendent may know little about the science of agriculture or the art of farming but may be an expert in school management and methods of teaching. His opinions and suggestions should be eagerly and cordially sought, and carefully and thoughtfully considered.

If they relate to activities for the success of which the superintendent or principal is chiefly responsible, his wishes ought to be regarded unless something in the teacher's work makes it practically impossible. If they relate to features for which the teacher is responsible they ought to be given an honest trial if there is a greater chance of succeeding than of failing, when applied to the particular conditions with which the teacher has to deal. When the supervising officer is present the class work should move forward in a perfectly usual and normal manner. The teacher should assume that the supervising officer has come in his official capacity to see the natural working of the school and not as a parlor visitor to be entertained. A good supervisor will do nothing in the presence of pupils that even hints unfavorable criticism. In a later conference between supervisor and teacher, full, frank discussion should bring out features commendable as well as those having a possibility of improvement. "Bouquets" as well as "brick bats" should be made evident by supervisors. The teacher should not resent criticism nor be unduly depressed by it. If it is just, let him appropriate it to the improvement of himself and his work. If it is unjust, endeavor calmly but frankly to demonstrate it to the critic.

The Teacher of Agriculture as Supervisor.—If the teacher of agriculture has charge of this subject in nearby rural schools, he then becomes the supervisor instead of the supervised. This double relation ought to keep him sane and sweet in both. Not only is the opportunity but also the motive present for exemplifying the golden rule. He should lay out the course of work, aid in obtaining materials, and give the teacher such help in the subject matter as she may need for the work she is to do. If he is to teach all of the lessons himself, she will need instruction on how to aid the children from lesson to lesson and how to have them prepare for the arrival of the teacher of agriculture. If she is to teach the

class each day of the week excepting the one on which the special teacher comes, she will need the topics to be studied during the week, the plan of class work and the actual agricultural knowledge (Fig. 14).

The day the agriculture teacher takes the class he can review the work, clear up questionable points, make the general assignments for the coming week and arouse the minds of the pupils to prepare for it. Unless the rural teacher is specially prepared in agriculture she will need all the help and encouragement and honest praise the teacher of agriculture can give, and he should not assume that she knows he is thinking these comforting things, but should tell her so and he need not be afraid to express approval of the work (when it can be truthfully commended) in the presence of the pupils. So far as we know, the corpse is not conscious of bouquets on the casket. Better present them when their fragrance is sweet to the soul.

Class Management Must Make Good Teaching Possible.— Schools exist primarily that boys and girls may be taught. The center of teaching is the class session. The acme of educational activity is the teaching of the class. Management, besides being a process of training pupils in social responsibilities and behavior, is a means of enabling teaching to attain its highest efficiency. As such it must create and maintain conditions most favorable to the teaching and learning processes. Since attention is the foremost essential to these processes management should affirmatively do those things that promote pupil attention and negatively prevent those things that distract it. The teacher should ask questions in a clear, well-modulated voice only loud enough to be distinctly heard when a proper degree of quiet is maintained; questions should be asked of the entire class to keep every pupil constantly participating in the progress of the thought of the lesson; generally the asking of the question should precede the designation of the pupil who is to reply; questions should be distributed with good judgment among the members of the class; if at all possible, every pupil should be given an opportunity to express himself during each recitation; the train of thought should be loaded with things worth attending to and should move rapidly enough to make attention necessary; the teacher should stand at a point where his presence helps to concentrate attention; teacher and pupils should habituate the physical attitude of respectful attention to the one reciting; the pupil who recites should stand (usually)

and if so, in an erect, well-poised manner so the other members of the class may easily concentrate their thoughts upon his recitation. These and many other features of good management contribute affirmatively toward superior attention.

Management may also assist in creating conditions favorable to the development of attention by preventing certain things. The senses of the pupils should not be assailed by persons passing open class-room doors, open windows, persons talking in the halls or the yard, the sputtering of a radiator, the tapping of a pencil, the falling of books, the whispering or speaking of one member of the class to another, persons entering the room or knocking on the door; and marking every recitation of each pupil in the class; the lighting and heating of the room should not be abnormal; conditions that make the orderly pupil anxious to set things aright, such as a flapping window shade, a piece of apparatus about to fall, the sunlight shining in the eyes of another pupil, the wind blowing the leaves of an open book, should be unobtrusively adjusted, and preferably, before the class enters the room, if possible. Besides other disadvantages of such things they distract attention of pupils and are evidences of poor management. Any pupil worth teaching will give his attention to *something* and the skilful manager will so plan as to enable him to give it to the right thing.

Necessity of Good Order.—Good order is absolutely necessary. Pupils cannot obtain the maximum results in education without it. Lack of teaching ability is harmful. Lack of governing ability is disastrous. More teachers fail from this lack than from all others. It is the *sine qua non* for success in the school-room.

The fundamental fact that the natural impulses and instincts of individual pupils so frequently run counter to the needs of the group or class makes government in the school-room a normal, perennial, continuous, ever-present problem. No teacher may pray to be delivered from it, no pupil may hope to escape it. Wise teachers and pupils will therefore coöperate in obtaining the maximum of benefit and happiness out of it by developing good government, which is a blessing, instead of permitting bad government, which is a curse. Good government will in turn result in good order and good discipline.

The Teacher Responsible.—The teacher is not only responsible for good management, but he is also responsible for good government, good order, and good discipline.

Other factors morally responsible for good school government, such as school officers, the public, patrons, and pupils, to the full extent of their powers *ought* to maintain good government in the school, but the *teacher must* do so.

Whether pupils coöperate fully in some form of pupil government or assume the most violent and malignant form of opposition to good order and good government; whether patrons render the warmest assistance or the coolest indifference and even frigid

FIG. 15.—A Wisconsin instructor of agriculture visiting a student's poultry project and examining the egg record. (W. C. Christenson and S. R. S., U. S. D. A.)

resistance; whether the higher administrative officers give firm and cordial support or fade away, "side step" or "stand from under" when their help is most needed and fully deserved; still the teacher by law, custom, and the opinions of the public and pupils, is expected to establish and maintain good government, good order, and good discipline.

The right of every child to obtain an education in the school must be protected and the teacher is charged with the duty of protecting that right. If he fails, all other factors are practically helpless and the child is defrauded of his birthright. In the per-

formance of this duty all of the teacher's mental, moral, and if necessary, his physical powers, may be called upon to serve, limited only by the laws of the state, the rules of the schools and the dictates of humanity. While in schools of the present day these limits need seldom be even approached, much less reached, yet most teachers will find opportunity to utilize all the tact, skill, patience, optimism, self-control, and strength of mind and heart they possess.

A Few Words to the Teacher of Agriculture.—There are several reasons why you should have little trouble in governing. Your subject is usually elective and you have not the perplexing problem of the uninterested pupil who is in the class because it is a required subject. Your subject has a content so concrete and naturally so attractive that the pupil's interest supplemented by even fairly good management and moderately skilful teaching ought to reduce disorder to the minimum. Your home project work makes so vital a contact with life interests that few pupils have time or inclination for mischief. Your visits to the homes enable you to come into contact with the parents on a constructive basis and thus assure their support and coöperation. You can also study the pupil in his out-of-school environment and be thereby the better enabled to work successfully with him in school (Fig. 15). The purposiveness of the school work, your ability to render him valuable assistance in the thing he is anxious to do and the manlike and adult character of your joint enterprises all unite to impel him to sensible, helpful coöperation so valuable in promoting good government. If you make a proper use of your opportunities, governing your class ought to be the least of your troubles.

EXERCISES AND QUESTIONS

1. Name five things that the teacher of agriculture may want to have done that need board action, but which are to be presented to the board by the superintendent. Name two, in behalf of which the superintendent may want the agriculture teacher also to appear before the board.

2. Name three subjects which the agriculture teacher and the superintendent should discuss fully and which on reaching a decision the superintendent should place in the hands of the teacher for the execution of the details of the plan.

3. Name five things which the agriculture teacher should do upon his own initiative without consulting the superintendent or principal.

4. Give specific instances in which the agriculture teacher can furnish definite aid to the teacher of botany; the teacher of English; to the teacher of geography; the teacher of home economics; the teacher of chemistry.

5. Give specific ways in which the teachers mentioned in Exercise 4 can help the teacher of agriculture.

6. Write an account of an important agricultural event and take it to the local editor for criticism. Rewrite until it meets his approval. From what you have learned write other articles and offer them for publication. (Chapter XVIII.)

7. Name five kinds of agricultural matter which you think the local paper would like to have. Obtain the criticism of the local editor upon your list.

8. State five subjects from which you think it advisable to select if asked by a farmers' club in your locality to "give a talk." State five others for use before a town business men's club.

9. Lay out a plan for your giving one lesson a week in a country school, the teacher of the school to conduct the lessons you arrange for her on the other four days.

10. Name five conditions or acts that might prevail in a class in agriculture; decide whether each is principally concerned with management, government, or the teaching process and in what ways it affects the other two.

11. Name five regulations intended to produce good government and decide whether they contemplate primarily the creating of favorable conditions in which the group can work or the development of the individual pupil in behavior.

12. Make a list of regulations that will tend to do both.

13. Examine the school laws and decisions of your state and see how many you can find that relate to the behavior of the pupil at school. What are the provisions?

14. What rules regarding pupil behavior have been enacted by the school board under which you are now working or last worked?

15. What supplementary rules regarding pupil behavior has the principal made?

16. What additional ones has the teacher made?

REFERENCES

BAGLEY, WILLIAM CHANDLER: "Classroom Management."
BAGLEY, WILLIAM CHANDLER: "School Discipline."
CHANCELLOR, WILLIAM ESTABROOK: "Class Teaching and Management."
COLVIN, STEPHEN SHELDON: "An Introduction to High School Teaching."
PERRY, ARTHUR C., JR.: "Discipline as a School Problem."
PERRY, ARTHUR C., JR.: "The Management of a City School."
STOUT, JOHN E.: "The High School."

CHAPTER IV

METHODS OF TEACHING

Teacher's Knowledge of Psychology and Agriculture Assumed.—The necessity of knowing the three M's—Mind, Matter, Method, is as great for the teacher as is that of knowing the three R's for the pupil. No teacher can hope to reach his highest degree of efficiency unless he knows the mind of the pupil and how it functions in learning, the subject matter of the curriculum he is to teach, and the proper methods by means of which the subject matter is used to educate the pupil.

This chapter is written on the assumption that the teacher of agriculture has a practical working knowledge of the psychology of education, particularly of the mental processes of learning. It is assumed that sensation, perception, conception, memory, judgment, reasoning, apperception, attention, interest, habit, imitation, emotion, thinking, will, motivation, association, and similar terms relating to mental processes are already significant to him. Therefore, no special treatment will be accorded them. If the one who desires to teach is not familiar with them, he ought to study carefully a few of the best books upon the subject, some of which are listed in the references at the close of this chapter and referred to by number at the close of this topic. It is also assumed that he has both a practical and a scientific knowledge of agriculture of the type prevailing in the region in which the teaching is to be done.

(References[1] at close of chapter: 1, 12, 13, 18, 23, 24, 26, 29, 30, 37, 45, 46, 47, 52.)

Some General Considerations.—As schools are organized there are three more or less distinct steps in the teaching process: The assignment of the "lesson," the setting of the task for the pupils by the teacher; the preparation—study—of the lesson by the pupils (and by the teacher); and the consideration of the task by the teacher and the pupils together—a joint meeting—the recitation. In many countries, including our own, the recitation has been considered to be much more important than the other two and in the minds of many persons "methods of teaching" are interpreted to be methods of the recitation. Recently, however,

[1] Numbers at the end of each topic allude to references at close of chapter.

much greater consideration has been given to the value of proper assignments and even more thought has been given to proper methods of study.

Induction and deduction are modes of thought. In the former, the mind from its familiarity with individual or specific ideas or notions, proceeds to a general notion or truth common to them all. In the latter, the mind accepting a general truth or notion proceeds to the application of it to specific or individual notions. In brief, it may be said that the inductive procedure is best adapted to teaching the young pupil, to laboratory work, and to scientific discovery. Its procedure is largely from the concrete and objective to the abstract and subjective. Its advantages are that it gives clearness of comprehension; interest in the learning process; confidence in the general truth, rules, definitions, principles obtained; and independence of future action in the pursuit of knowledge. Its disadvantages are that it consumes much time; may lead to erroneous conclusions unless well guided and exhaustive; and is needless and wasteful as a teaching process when pupils have already in their past experience sufficiently traversed its essential steps. For its successful use in school it requires broad and deep knowledge and superior skill on the part of the teacher and these are not always present. It is expensive not only of time, but of equipment.

The deductive process is economical of time, especially with persons whose experiences have supplied the apperceptive foundation for a comprehension of the general truth; enables one to take advantage of the achievements of the ages and hence of books, libraries, and other storehouses of knowledge, and to start at the point where the scientists, discoverers and scholars have stopped; and is the natural process in applying to the practical affairs of life the discoveries made by study. In schools it increases the efficiency of the poorly informed or poorly trained teacher by supplementing her teaching with textbooks which are principally deductive in character. It is economical in equipment since in most of the school studies application requires less expense for equipment than does discovery.

Both induction and deduction are essential to every complete learning process. With certain types of pupils or subjects or lessons one may well predominate over the other, but there are few, if any, lessons in which each is not present in some degree even though the pupil or teacher may not be conscious of it.

In each of the methods mentioned later these two processes will be found to be present in varying proportions (1, 6, 8, 12, 13, 16, 23, 39, 44, 51).

The Formal Steps.—The followers of Herbart in Germany and in the United States have developed a standard form of teaching procedure called in this country the "Five Formal Steps." These "steps" have gained general recognition and acceptance as amplified and utilized by American teachers and writers. They are usually designated as, first, preparation; second, presentation; third, comparison (and abstraction); fourth, generalization; fifth, application.

The first step sets before the pupil the problem and arouses his apperceiving masses related to it. It consists in arousing in the minds of the pupils their past experiences and their accumulation of information and ideas which will lead to an interest in further knowledge, to a comprehension (apperception) of the new truths and a concentration of effort toward the accomplishment of a definite known aim. In presentation, new facts, or experiences, or ideas, in sufficient quantity and of sufficient variety and comprehensiveness are brought before the pupils to form a basis for the fourth step. Comparison and abstraction consist of detecting the characteristics of the different individual facts or ideas, and their likenesses and unlikenesses and hence the relations they bear to each other. Generalization discovers the common characteristics abstracted in the third step and states the finding in the form of a general truth or conclusion. Definitions, rules, and principles are types of the results of generalization. In the fifth step, application, the general truth evolved through the first four steps, is utilized for the interpretation of specific, individual cases.[2] The first four of these steps are distinctly inductive and have the characteristics and advantages of that system of procedure. The fifth is as distinctively deductive with all that is implied thereby. A more complete explanation of this step will be made under the "Four Formal Steps" later in this topic.

These five steps (including the four parts of the fifth step mentioned later) are necessary to a complete learning unit and constitute the inductive-deductive process.

The various "methods" mentioned later will be found to place a varying amount of emphasis upon these five formal steps accord-

[2] For more complete treatment see McMurry's "General Method"; Earhart's "Types of Teaching"; Bagley's "Educative Process"; Colgrove's "The Teacher and the School"; McMurry's "Method of the Recitation."

ing to the purpose to be accomplished. It must not be understood that all five steps are taken in every lesson. A teaching unit fulfilling the five formal steps might cover the work of a week or might occupy half a recitation period. Neither should it be understood that in the learning process the five steps are distinct from each other. In preparation truths may be presented that are new to some pupils; in presentation some minds are constantly making abstractions and comparisons and even leaping forward to generalizations or even going farther and seeking applications.

While much has been written upon the inductive development lesson and the five formal steps (of which the second, third and fourth are definitely inductive), less has been done for the deductive procedure.

Bagley [3] divides the deductive development lesson into four steps: viz. (1) the data; (2) the principles; (3) the inference; (4) the verification.

In suggesting its substitution for the mere "telling" of facts so common in education to-day he states that it (1) introduces organization; (2) gives meaning to principles previously mastered; (3) "supplies a motive for searching out empirical evidence and therefore makes intelligible the use of textbooks and source materials"; (4) utilizes the "puzzle" instinct; (5) reveals the need for future study; (6) amplifies the inductive processes (8, 10, 23, 44, 51).

The Assignment.—Under the system of organizing American educational institutions, it is assumed that the teacher and the pupils will be together for coöperative work at regular periods of a few minutes to an hour or two every day or once every few days; that the teacher announces at every session certain work for the pupils to do before the next session; that the interim is used by the pupil in preparation for his part in the next joint meeting and that likewise the teacher in the same time makes his preparation for the same occasion. This interim task set for the pupil is the assignment. Its importance is sadly underrated by most teachers. The fulness, thoroughness, and systematic character of the study during the interim and the richness and vitality of the succeeding meeting of teacher and pupils are frequently most largely determined by the quality of the assignment. Loss of time in study and recitation is avoided by a good assignment, while a poor one may cause almost a total loss of both. Besides its far-reaching effect upon the char-

[3] The Educative Process, p. 305–315.

acter of the study and the recitation, a superior assignment makes a definite contribution to the good government of the school by keeping pupils cheerful, busy, and orderly. Its character may vary somewhat according to the anticipated procedure at the joint session of pupils and teacher, whether it is to be a lecture, a recitation, a seminar, a quiz, a drill, or an examination.

However, there are certain characteristics that a good assignment should possess regardless of the kind of work that is to follow. The assignment should state the aim or purpose to be accomplished. It should set the problem clearly before the pupil and should arouse in him a keen desire to solve it. By skilful questioning, it should establish vital contact in the mind between this problem and all possible related experiences of his own. To the extent to which this is done the assignment is the means of taking the first of the five steps.

The assignment should be clear and full. The pupil should know exactly what he is to do. The use of the assignment is not to be limited to the textbook type of study and recitation. Anything the pupil is to do as preparation for the next class meeting is a part of the assignment. It may be to study a portion of a book, to interview certain persons, to examine certain animals or plants, to observe certain processes, to attain by practice certain skill, to apply certain tests, or to collect and bring certain articles. Whatever it is, let there be no uncertainty as to what is to be done.

The assignment should make clear the manner in which the work is to be done unless the finding of a suitable manner is the problem involved. Suggestions as to the mode of attack are often permissible and valuable. Difficulties which the pupil cannot surmount without an expenditure of time and effort out of all proportion to the benefit received should be cleared up sufficiently to enable him to utilize his time to the best advantage.

If references or sources are to be consulted by the pupil, they should be given specifically—page or chapter—if necessary to avoid loss of the pupil's time. Besides the general assignment to the group, assignments may be made to individual students. This is particularly desirable if the pupil is capable of more work than the others, is especially interested in a particular topic, or has special facilities for accomplishing a particular assignment.

Under certain circumstances, especially where the assignment contains technical details and is long, it is well for the teacher to furnish to the pupils duplicated copies of these details. This

should not release the teacher from vitalizing the assignment with the means above mentioned. When the assignment is too detailed to be easily remembered but not sufficiently so to demand duplicated copies, the pupils should be required to make the notes necessary to insure good preparation.

The teacher should make as careful preparation for his assignment as for his recitation. Thorough preparation for the assignment is time saved on preparing for the recitation. He should know his pupils, their capabilities, their interests and their home facilities (if any home work is to be done and, of course, there will be in agriculture); he should know the aim not only of agriculture but of each topic to be taught; he should know the references available and their relative merit for that specific assignment; and he should know the more important and less important features of the particular problem under consideration.

When shall the assignment be made and how much time shall be taken? Assignment at the beginning of a class session for the succeeding meeting of the class has the advantage of insuring plenty of time for the assignment and avoids breaking into the continuity of the class session, but unless the succeeding lesson has no connection with the present one there is danger that the assignment will need to be changed because of developments arising from the present lesson. If the lessons have a pedagogical or logical sequence it is better to estimate carefully the amount of time that will be required and close the class period soon enough to make the assignment fully. Take plenty of time. Remember that the assignment of the lesson and the study of that lesson by the pupils cover usually the first of the formal steps, usually most of the second formal step, and frequently parts of the third, fourth, and fifth steps. When to this is added the effect of the assignment upon the study and the next class meeting it will be seen that when the assignment is well made the learning is well on its way (2, 3, 5, 8, 9, 10, 13, 14, 16, 49).

Study.—Generically "study" has several meanings, some of which are highly technical. Herein it is applied to the activities of the pupil upon the assignment in making ready for the next meeting of the class. This view does not limit it to the use of books. If the class meets to hear a lecture from the teacher, the study may be of references given that will prepare for a better comprehension of the lecture. If the work is in the laboratory it may be the performance of an experiment or demonstration of field work

in preparation therefor. As pointed out under "assignment" it may be any one of a variety of tasks.

In the public schools, where the laboratory and lecture methods are less used than in the college and where the pupils usually use books for study and pursue their study with little or no aid from the teacher beyond that given at the time of the assignment, the study period is of great importance. Upon it the pupil depends for much of his education. The value of the class meeting later is contingent upon it. The ability of the student to become independent and self-helpful depends upon his developing right ideals, plans, and habits of study. His tendency and capability of continuing his studiousness after leaving school depend more upon the power and habits of study he has developed than upon any other one school acquisition. Such habits must be so fixed as to become a part of his life.

It is a test of both the assignment made and the recitation anticipated. If pupils are keenly attentive, purposefully, happily, and diligently working, it is safe to conclude that an assignment is well made and that they are looking forward to a class session that is to be well conducted. It is a time-saver, especially in the process of acquisition which our crowded school conditions with little of the teacher's time available for each pupil demand that we utilize to the best advantage. Fortunately our superior textbooks, reference materials, and laboratories make this possible. To use this period properly every teacher should *know how to teach pupils to study.*

Teaching How to Study.—Space permits only a brief treatment here. For more complete information the teacher is referred to the references at the close of this topic and particularly at the foot of this page.[4]

The psychology of study, well treated in these references, must conform, of course, to the natural processes of learning. The teacher must make these processes possible. He must see that the physical surroundings of the studying pupils are helpful; that his management contributes quiet and orderliness; and that the assignment was properly made, furnishing a well-defined aim, necessary references and directions, a motive, and a general plan of attack.

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[4] See especially, Earhart's "Types of Teaching"; Strayer's and Norsworthy's "How to Teach"; Colgrove's "The Teacher and the School"; Hall-Quest's "Supervised Study"; McMurry's "How to Study."

To these he must add definite training of the pupils in study procedure and habits. These will vary somewhat according to the degree of advancement of the student, the character of the subject matter, the manner of conducting the class meetings, whether the pupil is to study at home or at school, in the schoolroom, the library, the laboratory, or the field, whether his study is to be supervised or unsupervised.

Regardless of these variations there are some fundamentals that are essential. There should be a plan. This plan should require a problem, interest, attention, and concentration, available data, a careful analysis of data, thoughtful consideration of the relations, deliberate drawing of conclusions, such verification and application of the findings as the particular conditions may require and sufficient intelligent repetition to make possible retention and recall for future use. It may also require some suggestion from the teacher if the pupil is to present it to the class.

During the working out of this plan the teacher may well give definite instructions, aid, and practice in such steps as consulting references, making outlines, taking notes, formulating conclusions, cultivating attention, and efficient modes of memorizing.

Supervised Study.—It is not enough that the teacher *tell* pupils how to study. He must work with them until the process is thoroughly understood and then require its performance until it becomes a habit. When a new mode of study is demanded by new conditions he should prepare them for it in the same way. It seems like a great consumption of time, which it is, but it means much time saved ultimately both for pupil and teacher. For this duty the teacher should prepare himself as carefully as for his class teaching. With the large amount of literature on this subject available, there is no good reason why every teacher should not prepare himself (2, 6, 10, 11, 13, 14, 15, 16, 19, 24, 29, 39, 40, 44, 45).

The Teacher's Preparation—*Lesson Plans.*—The teacher should have a thorough knowledge, which he obtained as a student, of the subject in general and of the particular portion of it he is to teach in a given class meeting. But this is not enough. He must have a knowledge of it from the point of view of one who is to teach it to others, which is different. He must rearrange his knowledge of subject matter and must have a definite teaching plan. This is especially needful if his student knowledge was received in lecture form at college and he is to teach it to noncollegiate pupils.

In reorganizing his knowledge he must choose those portions most important for this particular class to learn, arrange them in the order best adapted to their psychology of learning, group them into teaching units, and keep his knowledge up to date. This done, he should prepare his plan of conducting the class work on each unit.

The lesson plan for any given unit should be thoroughly worked over and written before the assignment is made to the pupils, for the pupils' preparation and the teacher's preparation for any given class meeting ought to harmonize in plan. Teaching is so complex, there are so many byways, inviting to both teacher and pupils, there is so much to be taught in so short a time, and confusion is so easily created, that a definite aim and a definite plan for reaching it are essential. This aim and the details of its working out constitute a lesson plan. In addition to the values mentioned such a plan contributes to clearness of comprehension, to ease of retention and recall, and to orderly habits of study on the part of the pupils.

What shall such a plan contain? Since it must be in harmony with the learning process it must deal with matter and method. Most teachers provide two adjacent columns or pages in the written form with the subject matter on the left and the method on the right.[5]

The subject matter column or page contains a brief sequential outline of the facts to be considered with important references to sources the pupils are to use. The method column contains an outline of the teacher's aims, the pupils' aim, directions, and the outstanding questions to be used by the teacher in conducting the recitation, and reference lists of materials to use. The material is so distributed in the columns as to bring the proper subject-matter topic horizontally opposite the appropriate method topic. Relative importance and relationship of topics are shown by indentations. The sequence of the methods column is that of the formal steps or such portion of them as is needed for this particular lesson. The plan closes with the assignment for future work.

Such a plan should be made out in sufficient detail to show clearly just what the teacher means to do and how he means to do it, and also what the pupils are to do, and how they are to do it. If review is necessary at the beginning either to strengthen the pupils' grasp on former lessons or to arouse their "apperceiving

[5] See Strayer, "The Teaching Process," p. 173; Earhart, "Types of Teaching," p. 237; McMurry, "Method of the Recitation," p. 329.

masses" for the second of the formal steps it should be included. If drill is necessary to acquire facility or to fix for future use it should be included also. Whether the aim is knowledge, skill, appreciation, or something else, the lesson should be properly outlined. If there are aims subordinate to the main aim they should be included. Most plans provide for advance work only, but if testing or review be a part of the recitation they should be provided for also. Like provision should be made for summarizing when that is desirable.

The extent to which the plans shall go into detail will vary. Inexperienced teachers should write theirs out fully and have them rigidly criticised until they have developed a good technique in plan making and until thinking out their work in that form becomes habitual. As they grow more proficient, the plans may become correspondingly briefer. Ultimately it should not be necessary for an experienced teacher to commit to written form the lesson plan of a subject with which he is familiar but the time should never come when he goes before his pupils without having carefully thought out his plan and assembled the necessary materials to be used. Lesson plans once written should be carefully preserved for future reference.

A few general comments may be helpful. Making lesson plans seems very laborious. It is, but there is a rich reward for the teacher who schools himself in it conscientiously, and even richer ones for his pupils. See that the aims are sufficiently comprehensive, but not too remote and intangible. Interpose immediate aims if the general aim is not sufficiently motivating. The type form of procedure [6] lends itself to the making of a comprehensive lesson plan extending over days or weeks. When such a general plan is used, specific plans should be provided to guide each day's work. In making plans the pupil's capabilities, attainments, interests, and point of view must be kept in mind. The plan should contemplate finishing the instructional work in plenty of time to avoid the assignment being crowded and consequently inadequate (8, 10, 11, 14, 16, 26, 34, 44, 48).

Class Meeting.—Assignment and the study have been considered. It remains to consider the class meeting.[7] This class

[6] See McMurry, "Method of the Recitation," p. 236.

[7] The term "class meeting" is used to avoid the confusion arising from the double use of the word recitation, its generic sense meaning any gathering of teacher and pupils to consider a lesson and its specific meaning such a meeting conducted in a "reciting" manner.

meeting is a vital complex wherein past experiences are revivified, new knowledge introduced, errors corrected, power developed, skill perfected, plans prepared, and emotions and aspirations aroused. Learning can take place without it but at a sacrifice of time and effort and of soundness and fullness.

The great importance of the class meeting and the invention of such aids as printing, and school-room and laboratory equipment have given rise to many "methods" of procedure during this class meeting, the most common of which every teacher should know and be able to use, and to which we shall now give brief consideration.

The Topical Method.—In this the pupil tells what he can about a given topic. The topic may have been in the general assignment, or may have been a special assignment to that pupil, or proposed by the teacher at the moment, or a part of an outline placed on the board by the teacher or a pupil, or developed by the class during the meeting.

It is less direct and specific than the question and answer method as usually used. It requires greater ability to organize and express on the part of the pupil than do many other methods and is therefore better adapted to the advanced students than to beginners, though in a simple form, especially in narration, it may be used with quite young children. Among advanced students it cultivates reflection and expression not only in narration and description, but in exposition. It is well adapted to review and to the second formal step, the presentation of new knowledge.

When the teacher requires it to be full, accurate, well organized, and well expressed, especially if the assignment has been skilfully made, it overcomes the tendency to memorize the text or to seek brief specific answers to problems which ought to receive a fuller treatment. It is a good test of the teacher's assignment and of the pupil's extent and method of study. It is a preparation for the "written lesson" to which it is easily adapted.

It is a good form of class exercise when the assignment has been based on the textbook, reference book, laboratory, or excursions.

To reach its full value and to avoid errors and misconceptions, a brief use of the question and answer method should follow the topical recitation, the questions being asked freely by the pupils as well as by the teacher. Intelligent, constructive criticism of the presentation should be encouraged. Every teacher should labor to develop in his pupils skill in organizing their knowledge for effective topical presentation through his assignment, his guiding of the pupils' study, and his conduct of the class meeting (3, 4, 41).

There is no objection to using textbooks and bulletins in connection with the assignments of topics. If certain topics are written on slips of paper with the names of books or bulletins to be used for each topic, a slip may be handed to each member of the class. If there are as many topics as there are students, so much the better. Each student now knows he is responsible for his own topic and he feels that when he recites he will be presenting a topic which will not be old to the other members of the class.

In making the assignment of topics to individual students, it may be well to let each student take down his topic in the hearing of the rest of the students so that all will know what topics are assigned. This plan of assigning will take more time of the class than if slips are written in advance and handed to the students individually.

If there are more students than topics, some of the topics may be subdivided but even when they are subdivided there may still be enough students so that each topic may be assigned to two members. A double assignment of each topic allows for competition between two students. The adroit teacher will see the advantage of assigning a good and a poor student the same topic. The teacher may write each topic on two or three slips and thus avoid students knowing what others have the same topic. The instructor, of course, should keep a memorandum of what topics are assigned and to whom the assignments are made.

Reciting Topics.—The teacher must know the best arrangement of the topics to be recited. He should also know what students are most likely to fail, or partially fail, in the assignment made. When it is found one student has failed to cover his topic well, it may be advisable to have another student report more fully. In case no other student has been assigned the topic, a reassignment may be necessary. Sometimes reassignments may be made under related headings so adroitly that the members of the class and the failing student do not know that it is a reassignment. Often new phases are suggested by the research of the student. These will usually call for additional assignments.

The Question and Answer Method.—The question is the universal condition precedent to learning. A question—a problem—"wanting to know"—have in all ages prompted the infant to reach for the colored ball, the chemist to mix the ingredients, the explorer to scale mountains. Asking questions of others is equally universal.

The inquisitive child at home, the lawyer in court, the traveler on his way, the farmer in his field, the doctor in the sick-room, the teacher in his school—all are depending upon their ability to ask questions of people or of nature and to interpret the replies.

It is not surprising that the question and answer method should be used more universally than any other. Though often abused it lends itself, when properly employed, to the accomplishment of more of the different ends of the class meeting than does any other one method. In accomplishing the three great aims of the class meeting, *testing, teaching, and training* (drilling), the "three T's", it is found about as valuable in one as in the others. Clear-cut, well-directed questions test the pupil's preparation and his present knowledge and disclose his errors and weaknesses, as well as test the teacher's success in teaching him. They arouse past experiences for use in present learning, and elicit new information to be incorporated with it. They provoke thinking to the end that new and general truths are found. They lead to the utilization of these truths in solving the most important problems of life. They prompt the intelligent and persistent repetition which stores away principles and processes where easy and accurate recall makes them available for future use. There is no type of learning in which the question, expressed or implied, is not found. Its gamut of application is large. It can be adapted to the babe in arms, the unlettered man on the street, or the philosopher in his study. It may require for answer only a single word, requiring practically no effort, or it may have occupied the thoughts of the sages of all ages and still be apparently as far from being answered as when the world began.

Is it any wonder that an instrument of such marvelous possibilities requires a skilful manipulation or that it sometimes goes wrong for lack of it?

As usually conducted, the teacher asks the questions and the pupil answers them, though in well-conducted class work the pupils are free to ask questions. This method enables the teacher to direct the development of a subject along its most valuable paths, prevents monopoly by individual students, and is well adapted to those assignments dependent upon books, laboratories, and excursions for their preparation. It is of special value in the teaching process, particularly in the first formal step. Among dangers in its use are that it will result in fragmentary study, thought, and expression, and that the teacher will rely upon it when other methods would produce better educational results.

Skilful questioning is a real art, an effective means of teaching, and a strong influence for good order and good government. Poor questioning is all too common and is responsible for much loss of interest, wandering of attention, poor preparation of lessons and even outright misbehavior in class. With so much at stake, every teacher should study to perfect himself in the art of questioning. The following suggestions may be helpful:

In form, questions should not slavishly follow the text either in language or sequence. The question should not contain the thinking which the pupil ought to do in answering it. A mere fact question may sometimes be justifiable but should not be used when a question can be substituted for it which not only requires a knowledge of the fact, but also of its relation to some other fact or to a principle.

The proper sequence of the recitation should be determined when the lesson plan is made and the questions should mainly follow this sequence. A "Yes" or "No" question is permissible when careful thinking is required to answer it correctly.

In construction and diction the question should be the best possible formulation of the inquiry made and should be so definite and clear that a properly prepared pupil of the class to whom it is addressed can have no possible doubt of its meaning. Such questions need no second formulating. Keep the number of fact questions small in comparison with the number of thought questions. Ask few questions and make them vital. Make the questions as attractive and thought-provoking as possible. Sometimes a question that even startles the class is permissible. Avoid questions that lead to "snap judgment" or guessing. Remember that the character of to-day's question reaches forward and determines largely on the part of the pupils the character of tomorrow's study.

In conducting the questioning, see that the questions are asked in a voice only so loud as to be heard when good order prevails. Hold the entire class responsible for hearing the question. Do not repeat the question unless the pupil called upon was not responsible for failing to hear. For a difficult lesson it is well to write out the questions before but not to lean upon them during the recitation. Ask questions of the entire class before designating the pupil who is to reply. Distribute questions well about the class. Do not concentrate on the bright pupils. Give one who fails another question. Let questions follow each other with enough briskness to hold attention, but give due care to the needs of nervous pupils and

of slow ones. Encourage pupils to ask questions, not only when one has an individual desire for an answer but permit them to question the class under proper circumstances. Sometimes have several pupils answer the same question without comment on the teacher's part, then let the pupils discuss the answers.

While giving due consideration to the desire of certain pupils for answers to their questions leading to some by-path, do not allow the class to be led astray from the task of the day. Do not permit the pupil struggling earnestly with an answer to be interrupted by pupils anxious to show they can do better. Do not interrupt a pupil for unimportant corrections. Encourage the pupil who is honestly striving to reply, if there is a fair chance of his succeeding.

Hold pupils responsible for replying to the class and so other pupils can hear and understand. Hold the entire class responsible for the correctness of the replies. Usually answers should be in complete, well-formed sentences, but sometimes when fullness of expression is less needed than some other characteristic and when a brief answer is perfectly clear and all that is necessary, brevity should not only be permitted but encouraged and sometimes even requested. In some forms of testing, some of development, and also some of drill, brevity is greatly to be desired. Where the search is for thought, answering in the language of the book is undesirable. Vague answers are no more to be permitted than vague questions. Do not complain of honest efforts to answer. Do not give the impression that answers are wholly wrong because they are not perfect. *Do not repeat answers.* Pronounce them adequate or inadequate and proceed. Utilize in every possible way past experiences of the class in answering questions, especially in a practical subject such as agriculture, where answers based on experience have unusual values. Even this may be carried to an extreme (3, 9, 10, 11, 42, 45).

The Laboratory Method.—The laboratory method is of the inductive development type operated under special conditions. In its usual form, the individual works alone under the supervision of the teacher to obtain knowledge new to himself though not necessarily to the world, or to make real what for him has been only theoretical. He usually works with material things aided by specific apparatus. It is usually concerned with the first two of the formal steps, though the others are sometimes included. Its most striking characteristics are those of being individual and inductive. Because of this it requires ability to work independently and with a certain

degree of manipulatory skill, and hence it is adapted to the advanced grades in school, though simple forms of object teaching related to laboratory work are adapted to the lower grades. It promotes careful observation and reflective thinking. It substitutes concrete reality for abstract symbolism, a step for which there is much need in these days of the domination of the printed page. It gives objective demonstration of a subjective principle or process. It develops keenness of observation, confidence in the soundness of knowledge, independence in habits of study, manual dexterity, and a mental attitude of inquiry. In its larger uses where it is extended to practicums and practical projects like those in agriculture, it develops the necessary motives, knowledge, and skill to enable the student to perform successfully the practical processes of the art. Of the three features of the teaching-learning process, testing, teaching, and training, the testing is frequently present, though the teaching and training are the most prominent.

The problem to be solved by laboratory work should not be a set exercise far removed from the lesson plan that is being pursued but should be a natural and sequential step in that procedure. It should grow out of the major problem with which the class is dealing and of which it is an essential component. Laboratory work administered in any other way cannot make its largest contribution to education. This raises a permanent and unsurmountable objection to fixed laboratory days with the fixed "lecture" or "recitation" days so prevalent in our college administration. This plan is all too common in our high schools where it is entirely indefensible as a teaching process, however necessary it may seem to be from the standpoint of administration. Some of our best high schools have succeeded in overcoming these administrative difficulties by the double period plan for all such studies.[8] Further reference will be made to this under topic "Combination Method" later in this chapter.

One of the great advantages claimed for the home project as a basis for school instruction is that it becomes a real laboratory, maintaining constantly a vital connection with the school work. Such a claim would be much more difficult to substantiate for the conventional laboratory exercises, isolated, fragmentary, and unproductive as they frequently are. Separated from the onflowing stream of learning they become mere bayous or even disconnected pools.

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[8] J. Stanley Brown in "School and Home Education," February, 1915.

The laboratory method is, of necessity, so expensive in time and money that every effort should be used to make it as highly productive as possible educationally. Proceedings should be carefully planned. Operations and materials should be ready before the work is to start. Things already known or that are not of sufficient value or that are too difficult should not be undertaken. Notebooks should be carefully kept, containing the problem carefully stated, the materials used, the processes performed, and the results obtained, with significant explanations and conclusions. The results of the laboratory work should then be incorporated into the general scheme of study and class meetings. The laboratory exercise itself furnishes little opportunity for expression in language. Laboratory work and materials adapted to the different agricultural topics are mentioned in Chapters V to XII, inclusive, devoted to those topics.

The three methods already discussed; viz., the topic, the question and answer, and the laboratory, are the three most important methods to be used in the public schools. While other methods have their minor values, the teacher who is expert in the use of these three need never fail for want of effective method work (4, 6, 16, 21, 22, 31, 33, 34).

The lecture method in its extreme form proceeds on the basis that teaching is a mere telling process and that all the pupils need to do is to think the thoughts after the lecturer. They are to think his thoughts after him in the class meeting and take notes. They are to think his thoughts after him during the study period and study their notes. They are to think his thoughts after him in the examination for which they prepare by studying their notes.

In the class meeting there is no testing; that is left for the formal examination; there is no training in the proper use of the term and what there is of teaching is reduced to the mere process of "telling." The natural processes in learning are assumed, not performed. It is needless to say that such a method has no place in the public schools, either high schools or grades or rural schools.

At the other extreme the term "lecture method" might be applied to any step in the educative process in which the teacher "tells" something to the pupils. In this sense this method is effectively used daily in every kind of school with every type of subject matter from the kindergarten to the university. Between these two extremes each teacher must decide for himself the degree in which he will use the lecture method and the form which it

shall take, considering his pupils, the subject matter, and the aids available.

In the college and university the extremely rigid and barren form first mentioned is improved by references for further study, quizzes, laboratory work, discussions, opportunities for questions and outlines, term papers, written lessons and other forms of student participation and real teaching processes. Even with these modifications and accessories *the set lecture is not justifiable in the public schools* as a regular method of teaching, even though on special occasions it might be justifiable as a diversion. It is defended in college on the grounds that no books are available with exactly what the instructor wants and in just the form in which he wants it; that books are not up to date; that books are not adapted to this particular class; that the teacher can organize better than the pupils can; and that it saves time.

However valid these claims may be for certain subjects in certain colleges, it is safe to assert that in the public schools the objections to the formal lecture as a regular method of teaching far outweigh its possible benefits. It utilizes too little pupil activity. It gives little opportunity for collecting and organizing information, comparing and evaluating it, drawing conclusions from it, and applying these to practical affairs. It concentrates the attention upon note taking instead of upon independent and constructive thinking. The sources of information are not available later for contemplative perusal and study. It may contain material ill-adapted to the pupil's state of mind. It makes no provision for the pupil's state of mind as aroused by some step in the teaching process. It violates many of the laws of learning. It is a poor use of that vital and precious period of the meeting of pupils and teacher when so much real teaching (instead of mere telling) could be done. It has been aptly characterized as a lazy man's method, since it is far easier to "tell" pupils than to educate them to study, to work in the laboratory, to compare, to think, to express, and to apply.

The informal use of the "telling" method is of inestimable value in some phases of public school work. While pupils are gaining possession of the tools of learning before they can utilize such sources of information as the printed page and the laboratory and such means of expression as writing, drawing, and other forms of hand activity, the teacher must tell much. Even throughout the school course it has its legitimate uses. The teacher by talking may give a most animated beginning to a new subject, thus inducing the pupils

to attack the problems with vigor. He may supplement the best results the pupils are able to obtain from their available resources. He may amplify topics of local importance, especially in agriculture and the sciences, much beyond the treatment accorded them in the texts and references. He may explain sets of slides and reflectoscope reproductions and thereby give them added significance. He may supply the connective tissue for the knowledge obtained from the textbook, the references, the laboratory, and the field observations. He may utilize correct knowledge not otherwise available. Not all things can be "developed"; some must be presented direct to the pupil. When for whatever reasons these are not otherwise available the teacher can tell them. But he should be careful not to tell them what they can advantageously find for themselves and which they would enjoy finding. Neither should he tell them what they already know. If any one is to tell that let the pupil do it.

College trained teachers are prone to lecture in the high school. Their first step in teaching should be to abandon it absolutely, returning toward (not *to*) it only as they can trust themselves to use it in a sound pedagogical manner. Let them remember that both expert observation and stenographic reports show very plainly that in the class-room almost universally *teachers talk too much.*[9] It will be shown later that the four methods above mentioned properly combined constitute the soundest class meeting procedure (3, 6, 8, 11, 21, 22, 23, 31, 33).

The Problem Method.—The problem method in its simpler form includes the transformation of an unknown quantity or condition or factor into a known quantity or condition or factor through the aid of those already known, such as making known the value of several articles when the value of one and the number of articles are known. In its larger forms, especially as found in agriculture, it places the emphasis upon doing something and is devoted to discovering from known or knowable conditions the best *way of doing* that thing, as *how* to repair the fence, *how* to raise a corn crop, *how* to make a profit from chicken raising.

It is not so much a method of teaching as it is a system of organizing the subject matter of the curriculum. As such it substitutes for the plan of cutting the subject matter up into small and more or less arbitrarily determined sections, the exact length of each being determined by the length of one day's recitation time, the

[9] Romiett Stevens, "The Question as a Measure of Efficiency in Instruction."

large problem with a set of minor problems within it, all of which lead forward to the solution of the major problem.

As stated in the topic on lesson plans, such a teaching unit might extend over the class work of a week or month or even a longer period. In following this plan of curriculum organization any or all of the methods of teaching (topical, question, laboratory, and others) may be used, as also may the different systems of class management. Induction and deduction, the five formal steps of the induction development procedure and also the four steps of the deductive development will be employed again and again with a constant intermingling of the various steps in the solution of the various minor problems. In agriculture such a problem (project) usually covers a definite unit of farm operation.

Because of the study looking forward to action and because of things being taught in connection with their natural surroundings and relationships, motivation, interest, attention and concentration and continuousness of effort are at their best.

In agriculture such a problem must impress the student as soluble and worth (to him) solving. It must be broken into smaller problems, for each of which data are collected; reflective thinking exercised; hypothesis proposed, rejected or retained, and verified; and a plan of action determined upon. In agriculture so much data is available that careful supervision by the teacher is necessary to prevent waste, discouragement, and, perhaps, abandonment.

The home project is a form of the problem system of organization much used in agriculture. In it large emphasis is placed upon the practical and skilful performance of actual farm operations under the supervision of the agriculture teacher of the school and correlated with the school instruction. It is dealt with more fully in Chapter XIII of this book.[10] The project method as applied to the conventional school studies has been treated in a volume by Dr. Charles A. McMurry (see references) (8, 9, 28, 31, 33, 34, 43).

Minor Methods.—In addition to the foregoing methods there are many others that are modifications or special applications of them. Among these are the Textbook, the Socratic, the Heuristic, Conversational, the Trail and Error, and the Field Observation.

The textbook method is not so much a method as the lack of a method. It is the slavish adherence to the textbook as the source of information, as the order of study, and as the sequence of

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[10] See also Stimson, "Vocational Agricultural Education" (Macmillan); U. S. Bureau of Education Bulletin, Report of Agriculture Committee of N. E. A.

recitation in violation of the psychology of the learning process and of any sound lesson plan that might be based thereon. It ignores induction, deduction, the five formal steps, development and practically all the mental processes but that of memory.

Since most textbooks are logical rather than pedagogical in their arrangement, this method does not utilize the natural motives and methods that appeal most to the pupils. As most textbooks contain condensed conclusions reached by the author, they present to the pupils many incomprehensible and unassimilable generalizations for which the method offers no adequate treatment. Textbooks should not be made to bear the blame that attaches to the textbook method. They are of great value and the American school would lose a part of its effectiveness without them. With a proper method of teaching they are a great source of strength. They are the universal source of information which is usually accurate and well expressed, often well illustrated and easily and economically available. They frequently contain problems, exercises, and suggestions of great helpfulness. They "tell" the pupil more and better things than could the average teacher and usually in an economical way, and do it while the teacher is busy with other things. They cultivate in the pupil the habit and ability of study and self-help which enable him to continue to be a student to the end of life. As a means of acquiring information and of developing skill in the application of knowledge they are invaluable. But between these two lies one of the most important steps in teaching for which they supply no method.

Usually the teacher who leans too heavily upon the textbook uses in the class meeting the least desirable forms of the question and answer or the topical methods limiting the sequence of procedure to that of the text and testing to accuracy in memorizing the language used therein (10, 23, 49).

The trial and error method, which, as its name indicates, consists of trials, the abandonment of the unsuccessful or ill-adapted and the adoption of the successful or well-adapted. Valuable as it has been in the evolution of the animal kingdom and the human race,[11] it is too wasteful of time and energy to encourage its use as one of the methods of teaching to be regularly used in the public schools.

The Socratic method is a form of the question and answer method in which the teacher takes the pupil with whatever

[11] "The Learning Process," p. 16.

knowledge the latter may possess and without the addition of any further information questions the pupil until he arrives at the new knowledge desired. It is long, circuitous, sometimes tedious, and usually time consuming. It is better adapted to individual than to class instruction and should not be allowed to consume the valuable time of the group of students for the sake of clarifying the thought of one student or the pride of the teacher in his Socratic skill (11).

The so-called conversation method is not so much a method of teaching as a type of class management in which freedom of expression and of questioning is allowed the pupils in the develop-

FIG. 16.—The agriculture teacher at the Hutchinson, Minnesota, high school gave his animal-husbandry class practice in stock judging at the county fair. (J. P. Shea.)

ment of the lesson. As a system of class management it is commendable when well conducted, especially in the first and second formal steps (34).

The field observation method is a form of the laboratory method in which the work done is a study of objects or conditions or processes instead of the performance of an experiment. It is of great use in all science subjects and absolutely indispensable in agriculture. To see things in their practical and natural surroundings, to utilize the wealth of neighborhood agricultural equipment, crops, stock (Fig. 16), soils, buildings and equipment, and the actual farm operations, to compare local conditions with general standards, to objectify and vitalize classroom instruction, to unify

home and school, to broaden the project work by a knowledge of what many are doing, to adapt the school instruction to the home conditions, and for many other purposes the agricultural teacher and his class should visit neighboring farms as a regular part of school work (Fig. 17). The details of what is to be done on these trips will be found in the Chapters V to XII, inclusive, which deal with the teaching of the different agricultural topics. It may be well, however, to mention here a few of the general regulatives that should be observed in conducting such visits.

The lesson plan should be even more carefully made than for an exercise in the classroom because the management conditions with which the teacher has to cope are much more difficult. The teacher and the pupils should have a definite aim and also well-defined and expressed subordinate aims. Definite written instructions should be placed in the hands of the pupils containing the plan of the trip, the hours, means, and purposes. It should contain specific instructions of what to see, do, and record. In some cases definite questions requiring careful observation before answering should be included. A clear understanding should be given of how the results are to be recorded. Before putting these into the hands of the pupils the teacher should go over the proposed trip and see if the conditions will enable his pupils to do what he proposes to require of them. He should then meet the pupils in the classroom, distribute the plans and see that they are thoroughly understood.

On the trip pupils should understand that it is not a holiday but a regular assignment of school work to be done in the best possible manner. They should be kept busy and orderly (with an order adapted to the type of work performed). They should be so supervised as to use plans to the best advantage. Their records should be carefully inspected and at a succeeding class meeting the results of the trip should be made a subject of systematic consideration by the group (22, 31).

The Heuristic method[12] is simply the inductive process in which special stress is laid upon letting each pupil find out for himself without the guidance and assistance offered by texts, teachers, and other aids. Properly combined with inductive development work or laboratory work in which guidance and sources of information are used advantageously it has pedagogic value. Used as an exclusive "method" it is wasteful, diffusive, likely to lead

[12] Monroe, "Cyclopedia of Education," vol. 3, page 260.

Fig. 17.—In utilizing the field observation method any kind of conveyance may be used and trips may be made at any season of the year, as shown by these loads of school pupils starting for the country to study certain features of local agriculture. (School auto-bus, R. H. Thompson, Okla. Agricultural teacher's automobile, W. V. Longley, Minn. Bobsled, A. A. Sather, N. Dak. Wagon, H. I. Schnabel, Calif.)

to erroneous conclusions, to unorganized knowledge, and to discouragement (30).

The written lesson is merely a form of class management in which the pupil writes upon a given topic or in answer to certain questions instead of reciting orally in response to the same topics or questions. Its value like that of the topic method and the question and answer method depends upon the choice of topics or questions and the treatment of the results. If results are given proper consideration, either privately or in class, the occasional use of such a lesson has definite value. To give a written lesson simply to relieve the teacher from conducting the recitation and not to use properly the results are both poor management and poor teaching. Pupils are seldom deceived. The making of agricultural booklets [13] as a type of written work, if properly managed and not overdone, has a certain value in teaching the pupil to gather and organize information and in cultivating expression. It is better adapted to elementary pupils than to secondary (3, 4, 36).

Combination of Methods.—When the teacher and the pupils have assembled in the class meeting, commonly called in public schools the "recitation," the best usage demands that none of the methods mentioned be excluded but each be used where it will prove to be the most effective. Every method named has its particular values and advantages as well as its dangers and disadvantages. Not the proper use but the abuse of any particular one need be feared. A good teacher, acquainted with his pupils, his subject matter, and the correct use of the different methods, knows which method to use at each step in the progress of the recitation. In most good recitations the question, the topic, the laboratory, the lecture, the Socratic, the conversational and others in more or less modified form will be skilfully interwoven to carry through a carefully conceived lesson plan. A pupil may present a topic, a teacher or pupil ask a question, the class turn to laboratory materials for observation and the teacher add vital information and display an object for illustration; four of the principal methods being used in only a small portion of the time of the class meeting.

If the best teaching is to be done, the organization of the program of recitations, the arrangement and equipment of the room, the character of the apparatus and supplies and the fixtures for their proper use as well as the type of class management must all be

[13] See Pickard, "Rural Education" (Webb), p. 331.

so planned that *a teacher can utilize any method during any portion of any class meeting period* without inconvenience to himself or to the class. (This, of course, does not include such modifications of fundamental methods as visits to other points.) All room arrangements and equipment should be made to conform to this as the fundamental necessity and the ability to utilize skilfully these facilities in such a combination of methods should be the final test of the teaching efficiency of the instructor.

The Conduct of the Recitation.—So much has already been said under other headings that bear directly upon the proper conducting of the class meeting that it seems unnecessary to say more. The proper conditions of health and bodily comfort; the observance of the natural processes of learning; the character and use of the assignment, the study period, lesson plans, various methods of instruction; proper organization, administration and class management; and many other things having a bearing upon the conducting of the class meeting have been considered. In addition to what has been said it seems wise to gather here some brief suggestions regarding the conduct of the recitation even though a part of them have been alluded to in other connections.

The Three T's.—The teacher should remember that the recitation includes the three T's, Testing, Teaching, and Training (drilling). They are not wholly separate and mutually exclusive. Testing contains some elements of teaching and training, teaching is more or less a constant testing and training (drilling), and training has its features of both testing and teaching. But in the recitation certain types of activities are directed to one of the three purposes. These three characteristics of the recitation may be made plainer by a more detailed statement of the aims of the recitation.

These aims have been stated and restated in more or less elaborate form by many writers. A brief and condensed résumé must suffice here. To *test* the pupil's preparation upon the assignment, his comprehension of the subject, his general knowledge, his accuracy, his ability to think, to judge, to apply and to use; to *teach* by pupils contributing the data they have gathered, by the teacher directing them in obtaining more data, by the teacher contributing additional data, by supplanting error with truth, by leading the pupil in the comparison of data and in the formation of conclusions and the application of these conclusions to the solution of new situations; to *train* in organizing knowledge and in proper expression, in acquiring skill in performance of processes, in

making the results of learning a more permanent possession are the principal aims.

Less Prominent Aims.—There are many less prominent aims, among which may be named: Keeping the learning process connected and continuous, arousing motives for intensive study, developing self-confidence in pupil and teacher, learning each pupil's characteristics, cultivating the mental powers, enabling a pupil to compare himself with others and to help them and to be helped by them, furnishing the teacher a check upon the quality of his teaching, and inculcating the many needed principles to guide human action in social surroundings. It is assumed, of course, that the recitation is to make its contribution to the attainment of all the general though remote aims of all education.

The test, if intended to determine the pupil's preparation for the recitation or his fitness to learn what is to be taught during that recitation, should be at the first of the period; if to determine his grasp of what has been taught during the recitation, it should be at the last. It should be well planned, brief, terse, searching, and rapidly conducted. Brief, significant, written replies to a well-prepared list of questions testing the preparation and disclosing the weaknesses needing attention can frequently be obtained, corrected, and results recorded in one quarter of the recitation period. This tests all equally, takes little time, and often enables the class to put the remaindeı of the period to a more valuable use by showing just what does and what does not need attention. Solving problems, making topical outlines from memory of the lesson or given portions of it is one other good method of testing quickly all members of the class.

The teaching portion of the recitation has already been treated quite fully in previous topics. A few cautions may be added here. The teacher should know his subject and this particular lesson, and not lean on the book nor much upon his written lesson plan. He should have ready everything needful for the period and have it in working order. He should insist upon good order, attention, promptness, and alertness. He should hold to the plan of the lesson; hold every pupil responsible for following accurately the progress of the work; keep every pupil thinking hard, actively, and continuously. No time should be wasted in taking dictation or copying. Such material should be prepared on a duplicator and furnished to pupils. Recitation time is precious and every minute should be made to yield a return which pupils will appreciate as worth their

while. Use objects, pictures, slides, charts, and diagrams plentifully but do not let time be wasted upon them. In all but classes of only a few members insist upon a pupil standing squarely on his feet for all answers of any length. Under all circumstances insist upon every pupil mentally standing upon his own feet. Permit no "coaching" or interrupting by the class. Insist upon clear thinking and succinct expression. Remember that the class is a group that must be taught and must learn as individuals. There is no vicarious learning. The doctrine of every fellow for himself is imperative in actually acquiring an education beyond the helpful environment which fellowship may contribute. Know your pupils, their capacities, interests, motives, and environment and adapt your teaching to them (1, 2, 6, 9, 10, 14, 16, 33, 50).

Drill as a feature of the recitation is treated as a separate topic.

Drill.—Even when a lesson has been well assigned, well studied and so well taught that comprehension, appreciation, and the knowledge of how to apply it are complete, the desirable processes are not necessarily yet complete. Certain portions of the subject matter, those that constitute instruments which the pupil will need in the future either to obtain further education or to perform the duties of life and which he cannot afford to depend upon searching out anew for the purpose, must become so fixed in their functioning that they become habitual.

The process used to "insure the functioning of the experience in habit" [14] is called drill. Since it is a habit-forming process it is governed by the laws and conditions peculiar to habit formation. The material to be drilled upon should first be clearly comprehended. Attentive and thoughtful repetition should then occur until retention and recall are automatic and the necessary skill in use is attained. Short periods of repetition under strict and undivided attention should succeed each other after gradually successively longer periods of rest from drill. This should be continued until the necessary degree of perfection is attained. The best form, stripped of all unnecessary details, should be chosen at the outset and never varied during drill.

Efficiency in drill is conditioned, within certain limits, by clearness of orginal comprehension, interest in attaining proficiency, persistence in repetition, the avoidance of monotony, the avoidance of variation, the avoidance of fatigue, and the satisfaction in the effect.

[14] Bagley, "Educative Process," p. 328.

Some of the most common of the impelling motives are appreciating the future need, the curiosity instinct, the emulation to excel either some one else or one's own record, the instinctive love of repetition, and the satisfaction in attaining skill. When these are inefficient the teacher must supply some more tangible incentives.

The abuses of drill by attempting to utilize it as a means of accomplishing comprehension, or appreciation, using it to excess, violating the laws of habit formation in applying it and wasting the time of the group drilling upon something for which only one or two were in need, have led to much criticism of drilling. But it has its place and is as necessary as are the other steps in teaching.

Charters [15] calls attention to the distinction between drill and application, defining the former as "the reviewing or repeating of a unit over and over again in the same situation" and the latter as the "use of a unit in a new situation." In this sense the use of drill in agriculture is much less needed than it is in the conventional studies. Agriculture, however, furnishes frequent and interesting opportunities for the repeated application of certain fundamental principles and processes. If the teacher is watchful of opportunities to apply them he will have one of his richest rewards: that of beholding his teachings functioning naturally in the daily lives of his pupils. Principles comprehended and understood are of little value until they eventuate in human action. Drill on the few things necessary, but place greater emphasis upon practical and successful application and in this give plenty of training in determining when and how to make the application (8, 11, 12, 14, 20, 34, 37, 44, 45, 49).

Skill may be briefly defined as proficiency in execution. To attain it two things are necessary: form and practice. Form can be acquired through trial and error (trial and accidental success), through directions and example, through external guidance, or through any combination of these. In acquiring form reflection on the various elements and their organization is frequently of value; imitation, instincts, automatic activities, ideas, imagination, ingenuity, experimentation, attention, and interest play their parts.

The second necessity, practice, can be obtained by drill the characteristics of which have just been discussed. After sufficient attention has been put upon the action to obtain satisfactory form, the attention should be held principally upon the results, not upon the process. Needless and conflicting actions should be omitted in acquiring form and avoided during drill. So far as

[15] "Methods of Teaching," p. 225.

possible, correct form should be adopted early before incorrect form has become habitual with all the difficulties attendant upon the breaking of a wrong habit. While good form is essential it is sometimes narrow pedantry to insist upon one form alone for all persons when some latitude may be allowed without any ill effect upon the skill. There are certain differences in persons that make a difference in form desirable. This is frequently illustrated in various athletic performances, in penmanship, and in applied arts. There is also some danger in teaching the skills that two much emphasis may be placed upon explanation and not enough upon imitation and execution. The real test of skill is the ability to execute with the desired proficiency and not the ability to describe and explain.

Skill, the *ability to do well*, is always at a premium. The world has always applauded and rewarded the man of skill. The schools have far too long exalted reflection to the exclusion of execution. The evolution of universal education demands that education shall not only be universal in that it shall include all the people but also that it shall be *adapted to the needs of all the people*. There are many for whom the grasping of abstract principles is difficult but who have great possibilities in the realm of the skills. For these the schools must provide an opportunity of education as well adapted to their needs as the old education has been to the reflectively inclined. Edward L. Thorndyke[16] says: "The taste for workmanship—the impulse to do the job as it should be done, making a first-rate product by a fit means — is one of the most easily developed, but also one of the best virtues. It is commonly more truly cultural or refining than an interest in correct manners, speech, or opinions about the fine arts, because it is commonly more sincere and less tainted with ostentation."

Farming is a combination of science and art. From the birth of man to the nineteenth century it has been mainly an art guided by the "rule of thumb." The development of the sciences during the nineteenth century and the establishment of the agriculture experiment stations in 1887 through joint state and federal action mark the real advent of scientific agriculture in the United States.

Agricultural science has done much to improve agricultural practice, but farm skills based on the trial and accidental success and the rule of thumb developed therefrom are still far too prevalent. Many of the farm skills need careful analysis, judicious elimination

[16] "Education," p. 48.

of the wrong and the useless features, effective synthesis of the correct and the necessary, and intelligent drill upon the perfected process. The schools and colleges have not yet done their share in this field. Highly skilful plowing, milking, grooming, stacking, cornhusking, cotton picking, pruning, spading, transplanting, rope work, horse training and scores of other farm processes dependent upon proficiency of motor control are far too rare.

The teacher of agriculture must do his share. Processes must be studied and analyzed. Pictures, slides, films, and actual performance must illustrate the proper movements. Practice in normal surroundings must furnish the drill necessary to produce proficiency and to make correct performance habitual. In teaching the processes dealt with in Chapters V to XII the teacher should use every possible opportunity to extend his teaching beyond mere theoretical comprehension into the field of actual execution (16, 18, 34, 37, 46, 47, 49).

Reviews.—As the form of the word indicates, the review is to view again that which has been the subject of study. The major purposes of a review are to obtain more complete comprehension and appreciation and to increase the probability of successful retention and recall. The attainment of the former is by means of regular teaching processes and of the latter by some of the processes used in drilling.

In the teaching the regular steps of induction and deduction may be used, the data being the larger and more important points made in the several lesson units or thought units instead of the smaller units used in the separate lessons to develop these larger points. The larger points are considered in their relationships, thus leading to a reorganization of the subject matter of one or more lessons on the basis of wider connections. The emphasis which has heretofore been upon the small groups of facts such as may be contained in a single lesson is now placed upon the large system which is created by the proper correlation of the conclusions reached in those lessons. Its psychological basis is that of old knowledge under the influence of the new and an appreciation of new knowledge by the aid of the old. This value is largely lost if the review is simply a retracing of the exact steps taken by the pupils in the original process of learning, however valuable such a process may be as mere drill. As a teaching procedure the review must be a new view. New data, new grouping, new comparisons must be added to illuminate the relationships, create

new associations and strengthen old ones. Application is frequently a very effective process in the teaching as well as in the drilling features of the review.

The drilling purpose is accomplished partly as a by-product of the teaching process of the review. Working over in the review lesson the knowledge acquired in the original lessons gives a repetition which improves retention and recall. But it is not safe to depend upon such casual repetition to furnish the necessary permanence in remembering especially if the new relationships are developed through the reviewing procedure. It is therefore well to have special drill upon the important points brought out in the review which it is desirable to have remembered.

Some of the other purposes of review are to test the pupil, to test the teacher, to develop the pupil's skill in the reorganization of his knowledge into large units and his power to discriminate between the important and the less important in what he has learned and to strengthen the weak points in the teacher's methods and in the pupil's knowledge and processes of learning.

The methods best adapted to the review are the topical (with its attendant, the written lesson) and the question and answer method. The laboratory method might be given a limited use whenever the test element is very large or the problem requires a new correlation of several previously more or less disassociated processes. The lecture method is wholly inadequate for review.

The principles utilized in drill features of the review are those that have been mentioned in the topics "Drill" and "Skill" of the foregoing pages.

The Teacher's Skill in Conducting Reviews.—As a test the review ought to be directed toward a comprehension of correlations and an appreciation of relative importance rather than toward the memory of details. To accomplish this it is necessary that the teacher make even more full and careful preparation for the review lesson than for an original lesson and that he conduct the recitation with the best teaching methods at his command. For while pupils ought to study to accomplish the remote aims of education, they are only human and are going to bring to the recitation the kind of material they think the teacher is going to ask at their hands. If the teacher demands scraps, isolated facts, unimportant details, and catch questions in the recitation that is the tale of bricks they will strive to bring, while if he requires underlying principles, significant features, vital relationships, and practical

applications and processes their study hours will be devoted to meeting his expectations. Though this difference is especially important in the review recitation every teacher should fully appreciate that his manner of conducting the recitation has more influence than has any other one factor in determining the preparation his pupils make for that important event.

When to Review.—The time of recurrence of reviews ought to be determined by the organization of subject matter rather than by the clock or the calendar. If the review is for the purpose of recalling former lessons as the step preceding the presentation of the new lesson, it should occur at the beginning of the recitation. If it is for the purpose of summarizing the results of the current lesson, it should occur at the close of the recitation. If it is to summarize and fix clearly in mind the elements of a given unit of subject matter it should be given at the end of that unit whether the unit be a part of one lesson or consists of several lessons. To review weekly or monthly regardless of the topics covered or their relationships is poor teaching. Within the limits of what has just been said short, frequent reviews are better than long, infrequent ones. The testing values of reviews will naturally come under the next topic (1, 9, 11, 20, 31, 44, 45).

Testing and Measuring.—Every teaching exercise regardless of the form or of the method pursued (excepting the lecture method in its strict use) contains in greater or less degree testing and measuring features. Experienced teachers, in order to know better how the means in use are accomplishing the ends sought in education, desire some more specific measure than is offered by the regular teaching processes. This is especially true in the work of the advanced pupils. Until the last score of years most of these tests have been of a subjective nature. They were based upon the judgment of the teacher or tester or examiner, which judgment was itself based (beyond what was learned from class work and reviews) upon tests, quizzes, and formal examinations. They were intended to give the teacher a knowledge of the pupil, the pupil a knowledge of himself, and the teacher a knowledge of the success of his own teaching. The teacher's knowledge of the pupil he could use to correct the faults in the pupil's education, to determine the classification and promotion of pupils, to decide the content and method of succeeding lessons and many other features of organization, management and method. The pupil's self-knowledge furnishes motivation and direction for his future efforts. The

teacher's knowledge of the success of his own teaching furnishes the basis for a readjustment of his methods.

An exercise so valuable in so many different ways cannot well be abandoned even though there are some objections urged against it. The complexity of the learning process, the crudity of present methods, and the importance of achieving the aims of education demand constant effort if we are to keep even approximately near to desirable standards. Measuring the results of our teaching is one of the checks used for that purpose. If the pupil is to obtain knowledge—then we must test to ascertain his possession of it and his ability to organize it and apply it. If he is to possess habits, we must test for the presence of the right habits functioning in the right manner. If he is to have skills we must test his proficiency in the performance of the particular skills and not merely his ability to describe the performance. Application and actual performance are so difficult to administer in schools that the written examination has been made to bear some responsibilities to which it is not well adapted. This is the origin of many of the objections that have been raised against it.

Written Examinations.—If formal written tests and examinations are to be given they should conform to the principles of questioning and the review already mentioned. In addition to what has been stated already a few suggestions are added here. If the examiner intends to assign different values to questions, pupils should know the assigned values before writing the answers; some choice may be allowed in regarding which questions shall be answered; and the results of the examination should not be over-influential in determining the standing of the pupil but due weight should be given to daily work, written work, and oral and written quizzes; the occurrence of the examination should not be determined by the calendar but by the pedagogical organization of the subject matter; examinations should be distributed throughout the year according to the last statement and should not be concentrated into one cramming, nerve-racking week; those physically unfit through youth, illness or abnormality should not be subjected to them.

Even with all that can be done to overcome the objections to subjective tests it is still urged that the results are unreliable because of the differences of knowledge, judgment, prejudice, and bias of those who record results. [17]

[17] See Starch, "Educational Measurements"; Finkelstein, "The Marking System in Theory and Practice"; Monroe, DeVoss, and Kelly, "Educational Tests and Measurements."

Objective Tests.—To overcome this much has been done in the past decade to develop objective tests based upon pupil performance in the art of doing. Rapid progress has been made in the production of standard objective tests for the common branches. While these represent a movement in the right direction, that of establishing a scientific objective basis, they are as yet open to the criticism that crudeness and imperfection mark the standards set and that the subjective element is still present in the creation of the standards, the application of the tests, and the interpretation of results. Many standard tests for the common branches are available for use at moderate cost. [18]

The teacher of agriculture has an excellent opportunity to utilize tests which have the merit of being objective, practical, and to some extent standardized. In exercises, practicums, projects, and other forms of doing he can easily see whether or not his teaching has been efficient. The final test of the efficiency of his work in the school will be whether or not the pupil wants to farm, knows what to do in farming, can do the thing skilfully on the farm, and, ultimately, whether or not he is farming successfully and happily. In addition to these evidences in the lives of his particular school pupils, there should be found tests of his community leadership in definite improvement in the farm and rural life practices in the community which has come within the sphere of his influence (1, 2, 6, 7, 11, 12, 14, 17, 20, 25, 27, 32, 34, 35, 38, 41, 44, 45, 47).

EXERCISES AND QUESTIONS

1. Give a specific illustration of the inductive procedure in a lesson. The deductive.
2. State circumstances under which the inductive steps ordinarily omitted should be used in an agricultural lesson.
3. State ten things which the teacher might assume as being known if his pupils were reared on local farms but which he would have to teach if his pupils were reared in town or city. What connection has this with induction or deduction?
4. Name five agricultural topics suitable for teaching by means of the "five formal steps."
5. Select one of the topics in exercise four and show of what each step consists.
6. What kind of process is used in finding, with the scales and the Babcock tester, the daily butter fat yield of a cow?

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[18] See Chapman and Rush, "The Scientific Measurement of Classroom Products"; Monroe, DeVoss, and Kelly, "Educational Tests and Measurements."

7. What kind of a process is used in teaching the reason for the dust mulch?

8. State five problems each suitable for the "aim" in an assignment.

9. Write a sample assignment for a lesson in agronomy.

10. Make an oral assignment of a lesson in poultry.

11. What are the objections to assigning the lesson by the textbook pages?

12. Show how agricultural journals may be utilized in an assignment; how farmers' bulletins may be used.

13. What are the advantages of making the assignment at the beginning of the recitation? At the close?

14. What are the most common faults in making assignments?

15. What special suggestions should be made to agricultural teachers regarding assignments?

16. Submit the plan of a lesson on finding the per cent. of stand of corn. One on selecting seed for one of the principal crops in your locality.

17. Outline in topical form for the purposes of a recitation a lesson on the construction of a poultry house.

18. Designate the topics in exercise seventeen, each of which would be suitable for a written lesson to occupy forty minutes.

19. Under what circumstances is a written lesson justifiable?

20. Make a list of the ten principal questions you would ask a class in a recitation on the humus content of soil.

21. Illustrate what is meant by a "leading" question.

22. What reasons are there to be urged against relying upon the formal questions printed in the text?

23. Recall instances in your experience of faulty questioning. (Avoid local personal allusions.)

24. State five problems in agriculture, each suitable for a laboratory exercise of thirty minutes.

25. State some of the abuses or failures of the laboratory method which you have experienced.

26. Name ten topics in agriculture in which laboratory work would be prominent.

27. Suggest ways and means of keeping the laboratory work and the recitation work connected.

28. Enumerate the objections to the lecture method in public schools.

29. Illustrate by specific examples the proper use of the "telling" method in a class in agriculture.

30. Attack or defend the statement that relying upon the "telling" method is a lazy man's procedure.

31. Show the relations between the laboratory method, the problem method, and the project method.

32. Make a list of laboratory exercises, another of practicums, and another of projects all in farm crops and adapted to your locality.

33. What are the objections to the textbook method?

34. Suggest five things that would tend to overcome the evil results of over-reliance on the textbook?

35. Write a series of Socratic questions that, without other aid, would tend to convince a man of his error who thought the potato was a "root."

36. Make a detailed set of instructions suitable for guiding your class in an observation lesson at a specified nearby farm.

37. Make a list of subjects suitable for agricultural booklets to be made by the seventh grade class.

38. Choosing your own assignment, write a lesson plan that will show the use of the question and answer, topic, laboratory, and telling methods in one forty-five minute period.

39. State the principal advantages of the combined method.

40. Choosing your own assignment, show how you would test, teach, and drill in one recitation period.

41. Make a list of questions adapted to the testing on the topic used in forty and formulate them so as to require clear thinking but brief answers.

42. Make a list of ten things in the agriculture lessons upon which you can justify drilling.

43. Name five farm "skills" that to your knowledge are unskilfully performed by many farmers in your locality.

44. To what do you attribute the lack of skill in each case mentioned in forty-three?

45. Suggest remedies for each item of your list mentioned in forty-three.

46. Make a list of points in the course in farm crops at which you would stop for review; in animal husbandry; in poultry; in farm management.

47. What recitation method do you prefer in the review? Why?

48. Make a sample set of examination questions to be used in the agronomy class including any instructions you would give to the pupils about them.

49. State the relative merit and lack of merit in letters and percentages as a means of recording the results of the work of the pupils.

50. Give yourself an examination upon a set of questions similar to these:

(*a*) Are my assignments clear, full, complete? Are they stimulating? Do they set forth a definite problem? Are references explicit and sources available? Are assignments carefully prepared before meeting the class? Do they contain modifications advisable because of discoveries made in the recitation?

(*b*) Do my pupils study to advantage? With zest? Do they have good systems of note-taking, of attacking problems, of organizing their findings?

(*c*) Are my lesson plans adapted to my recitation plans? Are they in proper sequence? Do they provide for sufficient pupil activity? Teacher freedom?

(*d*) Do I confine myself too closely to one method? If so, to which? Do I ask too few thought questions? Do I dominate the course of thought too much? Do I direct it too little? Do pupils ask enough questions? Are my questions well formulated? Are they sufficiently thought provoking? Do I repeat questions unnecessarily? Do I give time for thoughtful answers? Do I ask questions briskly enough to sustain interest? Am I heard? If not, why? Do I provoke disorder by my loud voice? Are my questions tactfully distributed among pupils? Do I permit talkative or unprepared pupils to rob the class? Do I permit vague answers? Do I habitually echo the answers of pupils? *Do I talk too much?*

(*e*) Do I have my room and materials ready before class time? Are laboratory materials and apparatus conveniently arranged? Are pupils seated to the best advantage? Are class- and pupil-movements well planned and routinized? Do I remove unnecessary sources of distraction?

(*f*) Do I lean on the textbook too heavily? Do I use objects, laboratory materials, field trips, and home observation assignments sufficiently?

(*g*) Are my drills purposive, well organized, and snappy? Are they adapted to agriculture? Do I pay enough attention to improving local farm skills?

When these have been answered, prepare a similar set for further tests of yourself. Use great care to see that you deal honestly with yourself in answering and in evaluating answers.

REFERENCES

[1] Bagley, William Chandler: "The Educative Process."
[2] Bagley, William Chandler: "Classroom Management."

[3] BETTS, GEORGE HERBERT: "The Recitation."
[4] BOURNE, HENRY E.: "The Teaching of History and Civics."
[5] BRIGGS, THOMAS H., and COFFMAN, LOTUS D.: "Reading in Public Schools."
[6] CHANCELLOR, WILLIAM ESTABROOK: "Class Teaching and Management."
[7] CHAPMAN, J. CROSBY, and RUSH, GRACE PREYER: "The Scientific Measurement of Classroom Products."
[8] CHARTERS, W. W.: "Methods of Teaching."
[9] CHARTERS, W. W.: "Teaching the Common Branches."
[10] COLGROVE, CHAUNCEY P.: "The Teacher and the School."
[11] COLVIN, STEPHEN SHELDON: "An Introduction to High School Teaching."
[12] COLVIN, STEPHEN SHELDON: "The Learning Process."
[13] COLVIN, S. S. and BAGLEY, W. C.: "Human Behavior."
[14] DAVIS, SHELDON EMMOR: "The Work of the Teacher."
[15] DEARBORN, GEORGE VAN NESS: "How to Learn Easily."
[16] EARHART, LIDA B.: "Types of Teaching."
[17] FINKELSTEIN, I. E.: "The Marking System in Theory and Practice."
[18] FREEMAN, FRANK N.: "How Children Learn."
[19] HALL-QUEST, ALFRED LAWRENCE: "Supervised Study."
[20] HARTWELL, ERNEST C.: "The Teaching of History."
[21] HOLLISTER, HORACE A.: "High School and Class Management."
[22] HUMMEL, WILLIAM GRANVILLE and BERTHA R.: "Materials and Methods in High School Agriculture."
[23] JONES, W. FRANKLIN: "Principles of Education Applied to Practice."
[24] KITSON, HARRY D.: "How to Use Your Mind."
[25] KLAPPER, PAUL: "The Teaching of Arithmetic."
[26] MCMURRY, CHARLES A. and FRANK M.: "Method of the Recitation."
[27] MCMURRY, CHARLES A.: "Conflicting Principles in Teaching."
[28] MCMURRY, CHARLES A.: "The Project Method in Teaching."
[29] MCMURRY, FRANK M.: "How to Study."
[30] MONROE, PAUL (Editor): "Cyclopedia of Education."
[31] MONROE, PAUL (Editor): "Principles of Secondary Education."
[32] MONROE, WALTER SCOTT, DEVOSS, JAMES CLARENCE, and KELLY, FREDERIC JAMES: "Educational Tests and Measurements."
[33] NOLAN, ARETAS W.: "The Teaching of Agriculture."
[34] PARKER, SAMUEL CHESTER: "Methods of Teaching in High Schools."
[35] PEARSON, FRANCIS B.: "The Vitalized School."
[36] PICKARD, A. E.: "Rural Education."
[37] ROWE, STUART H.: "Habit Formation and the Science of Teaching."
[38] SALISBURY, ALBERT: "School Management."
[39] SALISBURY, ALBERT: "The Theory of Teaching."
[40] SEERLEY, HOMER H.: "The Country School."
[41] STARCH, DANIEL: "Educational Measurements."
[42] STEVENS, ROMIETT: "The Question as a Measure of Efficiency in Instruction."
[43] STIMSON, RUFUS W.: "Vocational Agricultural Education."
[44] STRAYER, GEORGE DRAYTON: "A Brief Course in the Teaching Process."
[45] STRAYER, GEORGE D. and NORSWORTHY, NAOMI: "How to Teach."
[46] THORNDYKE, EDWARD L.: "Education."
[47] THORNDYKE, EDWARD L.: "Principles of Teaching."
[48] TWISS, GEORGE RANSOM: "Science Teaching."
[49] WHITE, EMERSON E.: "The Art of Teaching."
[50] WOODLEY, O. I. and M. VIRGINIA: "The Profession of Teaching."
[51] WOOFTER, THOMAS JACKSON: "Teaching in Rural Schools."
[52] WATSON, JOHN B.: "Behavior."

CHAPTER V

HOW TO TEACH AGRONOMY

"The specific aim of the work in Farm Crops is to enable young people to obtain such a knowledge of the characteristics, propagation, culture, improvement, storage, marketing, and use of the principal local field crops as will prepare them for success in field crop farming."—Report of Committee on Agriculture of the N. E. A. Commission on Reorganization of Secondary Education.

THE more restricted meaning of the term Agronomy is used in this chapter. As here used it includes the production of field crops and the marketing and uses of their products. The special part relating to soils, which is often included in the broader meaning of the term Agronomy, is considered in a separate chapter in this book.

The local character of the work in field crops as suggested in the foregoing quotation indicates that it is the intention of educators that in high schools at least the only crops of value in the locality are to be included in the studies made. Of course, crops which are not yet used in any region, but which ought to be grown there, should be included in the studies.

The vocational character of the instruction is also implied in the above quotation. If the work were not vocational, crops of other regions may as well be studied as those of the locality. In vocational schools, it is important that the work in field crops be devoted, first, to those crops which are of greatest economic importance in the region; second, to those which are of secondary importance in that region; third, to those crops which should be grown in the region or may well be introduced. If any other crops are to be considered it will be for the sake of broadening the knowledge of the students in the agronomy of other sections. And this phase of the work can hardly be considered vocational. Yet for college students and perhaps students in teacher training departments such crop would probably be included.

Northern students in vocational schools would probably not include such field crops as cotton, hemp, sugar cane and rice. Southern students in vocational courses would probably not consider the growing of flax and Canada field peas. In regions where tobacco is not grown it would probably be omitted. The same could be said of a number of field crops.

Relation of Agronomy to other Subjects.—The work in field crops is somewhat fundamental to the work in several other agricultural subjects. For example, it should come earlier in the course than soils and earlier than horticulture. Of course, the brief consideration of special soils for particular crops will be a part of the work with field crops. But in a course of study, a student should be expected to study plants before he begins to study soils.

The study of horticulture is more highly specialized than that of field crops, and the student is beginning on more familiar ground when he begins with farm crops. The subjects of agronomy and horticulture overlap somewhat in certain market crops, as potatoes, sweet potatoes, and cabbage. In any particular region the instructor of agriculture will be able to decide in which of these subjects to place such crops. If they are grown as field crops there, he can continue to consider them under that head. Otherwise they will naturally be included as garden crops.

Order of Considering the Crops.—First make a list of the crops which are to be considered in the study. Put at the head of the list those crops of greatest local or regional importance. These are put first for several reasons: (*a*) They are likely to be of greatest economic importance. (*b*) They will most readily gain and maintain the interest of the student. (*c*) They will form the path leading from the known to the unknown.

Next on the list place those crops which are little used in the region but which should be grown there for some reason, say as money crops, for stock feed, or as soil improvers. Examples in some regions might be soybeans or alfalfa, or crimson clover, or sugar beets, or rape for pasture.

In a third group place such crops as can be grown in the region and would be recommended for trial, but which are almost unknown there.

Lastly, consider crops of great economic importance to the country but not grown locally because of climate, moisture, or soil. Examples of this group for some regions might be peanuts, kafir, sugar cane, hemp, cotton in the North, and flax in the South. This would be non-vocational study.

Order of Treatment.—The direct or seasonal order of treatment should be used rather than the historic or the old logical order. By the direct order is meant the order in which the student would usually proceed in producing the crop. See the project steps in outline near the close of the project chapter.

Class Work in Agronomy.—The topical method of conducting the class work is easily applied to this subject. There are numerous topics which may be divided and subdivided. References should be made to the best texts, books, and bulletins. The sources of material are many. Arrange the topics according to the season. When it is time to select corn or other seeds, study seed selection. Study testing at seed-testing time. In the winter when field crop operations are few, study the enemies, varieties, and topics which may be illustrated from specimens. Suit the classroom topics to the laboratory exercises, field trips, and project work throughout the course.

Relating Topics to Projects.—There may be nearly as many projects pursued in the subject matter of agronomy as there are students in the class. Some may be growing corn, or hay, or pasture, while others are growing money crops, such as wheat, or oats, or cotton. Besides each student covering the topics of his own project, he may reasonably be expected to study the projects being pursued by other members of the class. Students will have considerable natural interest in each other's projects.

If students are all pursuing about the same projects in agronomy, it may seem difficult to the teacher to give individual topics to different members of the class and yet have the topics related closely to the projects being pursued at home or at school. This difficulty is less real than it may seem. The projects are long and continuous and cover so much subject matter that they may be greatly subdivided into numerous small topics. For example, if the student's project is the production of alfalfa, the associated topics assigned to individuals or pairs of students may be as follows:

Value of lime.
Signs of acidity in soil.
Why lime is needed for alfalfa.
Sources of inoculation materials.
Sources of seed.
Why humid climates do not produce alfalfa seed.
Best dates for planting alfalfa.
Methods of curing the hay.
Alfalfa as a feed on the farm.
Alfalfa on drained land.
The effects of infrequent cutting.
Duration of alfalfa plantations.
Forms of lime.
Compositfon of alfalfa.
Methods of inoculation.
Seeding of alfalfa.
How seed is produced.
Eradicating weed seeds from soil before planting.
Signs of when to cut alfalfa.
Alfalfa as a money crop.
Potatoes with alfalfa.
Improving poor soils for alfalfa.
The effect of pasturing.
Cultivation of alfalfa stubble.

Illustrative Material.—In every phase of the subject of agronomy, there should be an abundance of illustrative material present

for each recitation. Never think of having a recitation in agronomy without having considerable illustrative material present. If the study concerns corn, then samples of different types of corn should be in the room at recitation time to illustrate the points that are discussed. Corn of all types, on the cob, and shelled in bottles, corn products such as sugar, syrup, starch, oil, bran, breakfast foods gum, etc., stalks of corn, tassels, and silks shown on the stalk, if possible, should be present. Corn tillage implements should be available. Fertilizers and lime used on corn or other crops should be shown. Samples of bad weeds most concerned at the time or

Fig. 18.—At this Minnesota school, after studying corn and selecting the seed in the field, each ear is carefully tested in the school laboratory before planting time. (Lewiston Consolidated School.)

with the particular crop should be shown. It is better to study weeds in connection with the crops than individually.

Students should form the habit of hunting up the illustrative material in the room or elsewhere for each recitation. Attention of students to the illustrative material needed should be a part of the lesson assignment.

Of course, many of these materials may be kept in the room constantly but some of the materials should be fresh for each recitation. If the season will permit, fresh stalks of growing corn are better than dried ones. This is also true of weeds, grasses, legumes, grains, fiber crops, root crops, and others. Obtaining fresh specimens and other materials for each recitation should be a part of the work of the student, but plans for obtaining the materials should be discussed with the instructor.

In some cases the instructor will find it better to take the class out to the materials rather than to bring the materials into the class-room. If corn roots are to be studied, for example, it is better to make the study where the corn is growing. Students may learn to know weeds much better if they find them in the fields than if the weeds are brought to the class-room. The same is true of grasses, legumes, and other plants which are not familiar to all the members of the class. Frequent outdoor trips for such purposes should be made.

Demonstrations and Exercises.—There are so many exercises connected with the subject of agronomy that it is best to provide laboratory work several times a week for the performing of

FIG. 19.—Montana high-school students are learning to analyze seed samples for purity. (Carl A. Carlson.)

exercises which will accomplish several things: (1) Familiarize the student with methods; (2) demonstrate effects of certain treatments, physical or chemical; (3) make the student skilful in certain operations.

If regular laboratory work cannot be planned because of the schedules of different students, then it is more important that the demonstrations should be made in the class-room, and some exercises can be performed during the class period by students, either individually or in groups, or by the instructor assisted by students.

A number of exercises suitable for laboratory and outdoor use in agronomy are enumerated below, and a number of these may be repeated in connection with each of the crops studied.

1. Examine seeds for adulterations and impurities.
2. Test seeds for vitality. (Figs. 18 and 19.)
3. Score grains, corn, seed samples.

4. Identification contests.
5. Scoring stems of grain in the head; grasses, hay, legumes, and other samples.
6. Drill in rapid selection of seed corn in field.
7. Drill in storing seed corn by the string ladder method, and other methods.
8. Drill in selecting market grades of corn, fiber crops, and other marketable products.
9. Treat oats and other grain to prevent smut.
10. Drill in the identification of grass plants and their seeds.
11. Drill in identification of legumes and their seeds.
12. Drill in identification of weeds and their seeds.
13. Study parts of flowers, using each of the field crops.

Fig. 20.—This agronomy class in a Wisconsin high school is making a careful laboratory study of four varieties of potatoes standard in that state. (M. C. Christenson.)

14. Chart the market prices of crops for the year from published market quotations.
15. Study the morphology and composition of the potato tuber.
16. Harvest seed potatoes by hill-selection method.
17. Study varieties and groups of potatoes. (Fig. 20.)
18. Judge potatoes and other root crops.
19. Compare and judge the important types of tobacco.
20. Study and score many corn plants.
21. Study and score representative types of cotton plants.
22. Study types and select seed beans, cowpeas, soybeans, and others.
23. Compare weeds with reference to their length of life and places of growth (habitat).

Field Trips.—As already suggested, a number of the foregoing exercises may be conducted outdoors. There are numerous other

field trips which may be planned for outdoor study (Fig. 21). Take trips to the nearby farms where certain crops are growing, or where ground is being prepared, cultivation is going on, or harvesting is in operation.

On most of these field trips it is advisable to collect specimens of crops, weeds, insects, soils, and seeds. Such collections are merely incidental to the main study of the trip.

Planning a Field Trip.—It is best if possible to begin making plans for the field trip several days in advance. Certain preliminary studies may then be possible and are usually very beneficial.

Fig. 21.—These Iowa students are carefully studying crops in the field during the growing season.

Besides making preliminary studies through bulletins and books, an outline of the studies to be made on the trip should be given to the members of the class. Suppose that the trip is for the study of kafir corn during harvest period (Fig. 22). Some of the points to be included in the outline would be as follows:

Variety of kafir studies.
Color of seed.
Relation of weights of grain to stover.
Methods of cutting crop.
Method of cutting the corn from the stalk.
Time of the last operation, whether before or after curing.
Injury from sparrows, mice, and other enemies.
Protection and storage of corn.
Uses and prices.
Methods of marketing.
Methods of using the stover.
Fed whole to stock.
Run through a cutter before feeding.
Use as silage with or without water.
Experience of the grower as to feeding value, yield, adaptations.

If this be the first field trip with this particular crop, certain other studies with reference to distances of planting, suitable soils,

seasons of planting, preparation, culture, enemies, etc., may be included in the outline.

During the field trip each student should have his attention constantly held to the subject of the trip. This can be done by careful thought and attention on the part of the instructor. En route to the field students should be directed to collect five new kinds of legumes, five new grasses, or five new kinds of weeds, and help each other name them. This will cause them to make use of the time to good advantage.

In returning from the field let each student enumerate five or more points which he learned during the study. This will cause

Fig. 22.—Oklahoma students have learned that seeds of kafir, as well as seeds of other crops, should be selected in the field before the crop is harvested. (H. R. Naylor, El Reno.)

him to formulate or review the points which have been brought out at the farm.

While making the study at the farm the outline which has been prepared in advance should be taken up in a general way at first and then each point in detail answered by each student. Certain questions that are to be asked of the owner or manager of the farm visited may be asked preferably by the students, but they may be asked by the instructor if necessary. With high-school students it is well to try to cultivate their power to ask intelligent questions instead of depending upon the instructor to bring out the points.

Notebooks containing outlines for the trip should be used for the answers also. The points entered in the notebook should be the permanent property of each student. These should be carefully examined by the instructor or by monitors who are capable

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of pointing out the good and weak points in the notes. (See also Chapter IV.)

Subjects for field study should be found in the projects conducted by students, the crops raised in the neighborhood, and special operations in progress at different times. Some of the

FIG. 23.—These Wisconsin students are interested in studying corn smut in the field under the guidance of the teacher of agriculture. (S. R. S., U. S. D. A.)

topics for trips may be suggested by inquiries from farmers concerning certain field operations.

Home Projects in Agronomy.—So much has already been said regarding the importance of conducting home projects that no arguments in their behalf need be offered here. A suggestive list of projects which may be conducted for several weeks, months, or

years at the homes of students may be found of value to instructors and students. To make such a list complete would require entirely too much space here. Projects related to some of these will readily come to the mind of the instructor.

FIG. 24.—Home project field of corn destroyed by army worm. Controlled by poison bran mash. Below, same field after being protected. (J. A. Wisdom.)

1. Growing one or several acres of any one of the field crops for a single year, including preparation of soil, seeding, culture, protection against diseases (Fig. 23), insects (Fig. 24) and other enemies, harvesting the crop, curing, storing, marketing and record keeping, including cost accounting and profits.

2. Grow certain crops under two or more different treatments for the sake of demonstrating that certain treatments are better than others, but incidentally gaining all of the practice and skill (Fig. 25), which would be gained in projects outlined above. Some of the different treatments might be with and without lime for clover or alfalfa; with and without fertilizer for corn or potatoes; with and without certain fertilizer ingredients, as nitrogen or potash or phosphate, in the fertilizer mixture for any field crop; with and without

inoculation for certain legumes, as soybeans, peanuts, cowpeas, velvet beans, or alfalfa; with and without drainage for deep-rooted crops, such as sweet clover, mammoth clover, alfalfa, sugar beets, or mangels; small grains with and without treatment for smut; comparing the proportion of grain grown with and without listing; planting wheat on loose or firm seed bed; starting timothy and other grasses with and without the use of the roller; comparing the use of a rough roller with a smooth roller; without harrowing when sowing small seeds, such as millet, clover, or grasses; growing potatoes with and without treating the seed to prevent scab diseases.

3. Long projects may include rotation courses running through two, three, or four years. Such projects, however, are not well suited to school work because of the long time required.

4. Improvement projects may include improvement features such as growing corn by the ear-row method for the sake of increasing the yield;

FIG. 25.—Growing ten acres of wheat for profit makes a good home project for Missouri and other wheat states. (J. A. Wisdom.)

growing potatoes by the hill-row method for the sake of increasing yields; growing sweet potatoes, cotton, tobacco, wheat, or other crops that are subject to special diseases, and during the growth selecting those which are found to be resistant to the special disease.

5. In connection with livestock many agronomy projects may be planned. Produce certain crops suitable for pasture with hogs, cattle, sheep, etc. These pastures may be either permanent or temporary. Improve old permanent pastures by fertilizing, mowing, liming, harrowing, sowing more seed, or any combination of these treatments.

6. Soil maintenance and soil improvement should be included in agronomy projects. The production and use of green manures for one or more seasons to build up poor soils; the regular growth of green manure crops in rotation systems to aid in soil maintenance; liming and fertilizing which should accompany these operations, and all other efforts for soil maintenance and soil building. (See Chapter XII.)

7. Plan soiling systems and grow the crops for use during the entire season. This may be in connection with the feeding of hogs or of dairy cattle.

8. Good winter projects which may be either connected with or independent of some of the foregoing projects may consist of the management of the barnyard manure crop from a dairy or other barn. Comparisons of methods may be made in connection with the project.

9. Compare different varieties of the same crop with each other in field projects.

10. Compare different methods of curing certain hay crops. With clover or other crops which are cut several times, this project may run through an entire season, or longer.

11. Root crops may be stored by different methods after they have been produced during a season's project.

12. Certain crops, such as soybeans and cowpeas, may be compared with each other in yield of production and other points. Compare timothy and redtop. Compare red clover with alsike clover or with mammoth clover.

13. In pastures compare certain grasses and legume mixtures with others. Consider in this the amount of feed, permanency, palatability, effects on soil, influence of climate, and any other points.

14. Grow mangles and sugar beets and compare them in yield, cost of production, and feeding value.

15. Grow corn from seed selected from the crib in comparison with seed selected from the field. All methods used during the project should be otherwise alike.

16. While growing corn in any field project, comparisons may be made to demonstrate the effects of seed which is selected from good and from bad lots with reference to all of the points in the corn score card: good and bad tips; good and bad butts; large and small cobs; pure and mixed seed; long and short ears; mixed or uniform kernels on cobs; one or more ears to the stalk, etc.

17. Grow wheat by early and late planting to study the influence of the Hessian fly.

18. Grow cotton with and without the best methods of combating the boll weevil.

19. Grow flax chiefly for seed and chiefly for fiber, comparing the profits.

20. Grow small grains with and without sufficient soil cover to prevent winter blowing of soil.

21. Where possible, crops may be grown with and without irrigation to compare results in yields, cost, character of product, etc.

22. Compare results in depth of planting while growing Irish potatoes for a season.

23. Grow Irish potatoes by the level, high-ridging, and slight-ridging methods, comparing results.

24. Transplanting studies may be made in connection with projects that require transplanting, such as cabbage, tobacco, and sweet potatoes. If possible, compare hand and machine transplanting.

Agronomy Surveys.—To make complete community surveys of the whole field of agronomy would be very troublesome to the farmers answering the questions and would consume very much time on the part of the students and instructors. It is usually better to make surveys on limited topics. Some instructors have adopted the plan of using cards about 4 by 6 or 5 by 8 inches, which usually may be arranged in order of subjects and in alphabetical order. The questions of the survey are put on these cards with room left for the answers. The questions may be put on with

the mineograph or the hectograph. The cards are sent home by the students and are returned the next day or very soon. The answering of the questions on one card will not be tiresome to either the student or the farmer. A number of surveys may be made along through the term, each one of which is intensive enough to give the information desired for class study.

Unit Subjects for Agronomy Surveys.—Early in the term a list of the surveys in agronomy which will likely be wanted may be planned and arranged in suitable order. The following list may be suggestive:

Practice in green manuring and use of cover crops.
Methods of plowing and other tillage practices.
Soilage and soiling crops.
Silage and silage crops.
Methods of corn production.
Alfalfa and special legumes.
The clover group.
Small grains.
Pastures and hay crops.
Weed troubles and noxious weeds.
Field crop diseases and their control.
Field crop insects and their control.
Methods of producing root crops.
Special fiber crops, as cotton, flax, and others.
Sorghums, kafir, and millet.
Summer legumes: soybeans, cowpeas, and velvet beans.
Irish potatoes and sweet potatoes.
Special crops of the region, as sugar beets or tobacco.
Rotation systems.

Sample Outline for Small Agronomy Surveys.[1]—A suggestive outline is here given to be used or modified for any region where the survey is desired. These questions may be arranged on a card to suit its size and the space necessary for the answers. Suppose we are to study the subject of Irish potatoes. The answers to the following questions will be very helpful in the study:

Name of grower.
Renter or owner.
Acres of potatoes grown last year.
This year.
Yield.
Cost of soil preparation.
Date of planting.
What crop precedes the potatoes?
When is soil plowed?
Depth of plowing.
Number of harrowings.
Types of harrows used.
Method of planting.
Distances between rows.
Size of pieces.
Cost of seed per acre.
Sources.
Varieties grown.
Is seed treated before planting?
How?
Cost.
Is field harrowed after planting?
Times and methods of cultivation?
Cost of horse and hand labor for tillage.
Fertilizers used.
Rate.
When used?
Cost.
Treatment for insects.
Cost.
Treatment for blight.
Cost.

[1] See Survey suggestions, Chapters VI to XII.

Rows highly ridged, level, or medium when "laid by."
Hand hoeing or other tillage.
Methods of digging.
Time.
Is field harrowed and gleaned?
Is seed selected at digging time?
How?
Methods and rules for sorting.
Methods of picking, bagging, and crating.
Methods of storage.
Cost.
Shrinkage during storage.
Rate.
When marketed.
Prices received.
Cost of harvesting.
What crop follows potatoes?

Use of Survey Returns.—When the cards containing the answers to these or any other agronomy survey are brought back to the school, some study will be required to make use of the information contained therein. If the number of cards returned runs into the hundreds, it may be necessary to tabulate the answers. A small table relating to the acres, yields, cost, and profit may be made and the information entered in the table independent of other details. Another table may be made which will include soil preparation, tillage, methods, and harvesting. Still another table may include the points related to fertilizers, rotation, etc.

In case the number of cards returned is very few, not much larger than the number of pupils in the class, the work of adjusting the information is much easier. No tabulation is then necessary. The results regarding each of the points may be put on paper or cards. A heading of the subject or the question is written at the top of the card, and at the bottom are given the average or conclusions of the whole matter.

The work of summarizing a survey may be done by members of the class, each part being assigned to students working in pairs or other small groups. This work may be done during the regular study period for that subject.

The value of the information gleaned from such a survey is very evident to students and instructors who have successfully conducted and digested an agronomy survey.

Charts on Field Crops.—By referring to Chapter XVI it will be seen that suggestions are given regarding the making and use of charts in the teaching of agriculture. In the subject of field crops a number of special charts should be prepared. One good series of charts to be made by the student or by the school would be outlines of the different subjects. Let a chart be made giving a syllabus of the study of wheat growing, another on oats, barley, rye, millets, common clover, other clovers, small legumes, winter legumes, alfalfa, sweet clover, cotton, corn production, corn seed

selection, sorghums, sugar beets, mangles, Irish potatoes, sweet potatoes, timothy, pasture grasses, other grasses, etc.

Another good series of charts could be made from small published charts showing the distribution of each of the crops. A chart showing comparative yields of field crops would be valuable. A composition chart showing the relative composition of each of the farm crops as feed crops could be easily made.

Charts showing the relative production of each of the crops locally should be made. Take a single county, for example, and from surveys or from a census report show the relative production in bars of different length across the chart.

Make graphs from the results of the local surveys. Some of these may show the relative cost of production of different crops. Others may show relative dates of planting. Others may show yields. Others may show cost of harvesting, or cost of cultivation, or cost of any other operation of importance. When these graphs are placed on permanent cloth charts, they become very valuable for ready reference.

Charts showing different methods of treatment are easy to devise. Assign the task to students who have done tabulating or otherwise digested the results of local surveys. Suppose, for example, that the hilling of corn, or cotton, or some other crop is to be contrasted with level culture of the same crop. If the local survey or some one student's trial has shown a contrast in results under the two methods, let the matter be worked up into a chart giving the results of the two methods in figures, showing them in bars or in sectors of circles.

Methods of growing crops with or without lime, with or without inoculation, with or without fertilizers, with or without certain special soil treatments, as rolling or extra disking, may be good subjects for charts. If the crop be a hay crop, relative sizes of stacks or of hay shocks may be shown on the chart. Conclusions at the bottom of each chart may be expressed in a line or two of well-chosen words.

Other good subjects in agronomy for charts to be used in schools are composition of corn; structure of grains of wheat, barley, oats or rye; types of kernels of corn; types of heads of different varieties of wheat; heads of barley; methods of cutting potatoes; methods of tillage; types of tillage implements; cross sections showing structure of fanning mill, and cross section of threshing machine showing sources of waste.

Alfalfa Chart.—If it be the desire of the class to make a chart on alfalfa growing, the following may be the chief lines of the chart:

Select rich, well-drained soil.
Keep free from weeds and weed seed.
Choose pure, strong seed.
Sow at proper time.
Use proper amount of seed.
Inoculate naturally or artificially.
Cut frequently at right time.
Cure carefully.
Maintain field properly.
Supply plenty of lime.

Skills in Agronomy.[2]—Modern methods of teaching require that students become skilful in the chief operations which they are to perform in actual field work. Schools are rapidly getting away from teaching merely by theory. Practice must go with it.

Some of the chief operations in field-crop production which require skill on the part of the operator are the following: Plowing, disking, drilling seeds, sowing seeds broadcast, sowing seeds with hand seeders, seed corn selection, cotton seed selection, selection of seed wheat, seed oats, seed barley, etc., harvesting, hay making, judging maturity, judging condition of soil, judging moisture requirements and conditions, estimating yields, judging products for market.

Skill in Plowing.—This can best be taught by actual practice, but the student should consider a few things in advance: the adjustment of plows, the depth of plowing condition of soil, season, requirements of the crop to be grown next, etc. Let the student have practice in plowing under sod soils, as in plowing stubble land or green manure crops such as high weeds, rye, and clover.

Plowing contests may be organized and the work of each student judged according to the following points:

Uniformity of depth.
Uniformity of width of furrow slice.
Complete covering of material turned under.
Ease and manner of operation.
Perfect working of the plow, including scouring of the moldboard.
Rate of plowing and general appearance.

These points and any others which may occur to the judges may be used in formulating a score card for plowing. Let all of the operators have conditions which are similar, or as nearly alike as possible.

Instructors should judge the plowing done by students in their home projects. The score card will be useful for this purpose.

[2] See also Chapter IV.

Skill in disking is required in preparation of soils. Bad disking is often seen where the land is left in ridges, or where the center line of the disked strip is left unturned, or where the disk does not scour and therefore does not turn the soil well.

If desired, a score card may be made covering these and other points in disking.

Drilling Seeds.—Skill is required in drilling so that the stand of grain or grass or legume will be uniform and leave no vacant strips or thinly seeded strips. Too thick seeding is sometimes a fault. The chief points to be observed are: Adjustment of the sower; prevention of clogging by foreign materials in the seed bags; careful drilling to avoid lapping and skipping; laying off a true land by straight lines well sighted through the field; Adjustment of depth of shoes, hoes, or disks; condition of soil at time of drilling; constant and uniform supply of seed in boxes; frequent mixing of contents of box; quick discovery of failure of seed to drop in any of the tubes; suitable treatment of soils immediately after drilling.

Let a score card be made giving proper values to each of these points, with proper cuts designated for partial failure in each case. Let students study the score card and then practice drilling with each of the points in mind during the operation.

Other Methods of Seeding.—Certain portions of the score card may be revalued for use in scoring other methods of seeding, either by hand sowing, wheelbarrow sowing, fiddle sowing, crank sowing, or wagon-gate sowing.

Seed-Corn Selection.—Score cards have long been in use for the selection of seed corn. These should be used so that the points will come to the mind of the operator without consulting the printed page. Rapid selection is necessary. Let students take piles of corn and sort them into three or four grades. The instructor may frequently stop and question the propriety of throwing certain ears into the first, second, or third grade.

Field selection of seed corn is even more important to the educated student of agriculture (Fig. 26). Make a score card for field selection covering the following points in addition to those usually included in the score card already referred to:

Number of ears to the stalk.
Height of ears on the stalk.
Proportion of sterile stalks in the vicinity.
Degree of covering of tips by husks.
Degree of drooping of ear.
Size of ear.
Maturity of ear as shown by husks or otherwise.
Freedom from smut and other disease.
Other points.

FIG. 26.—Students should have actual practice in the field selection of seed corn. Upper, prepared for the work. Center, making the selection. Lower, corn in form for drying and storing. (J. A. Wisdom.)

Students should become familiar with this score card by practicing field selection and discussing each of the points for a short time. After this, considerable drilling may be advisable so that the operator will almost intuitively select the proper ears.

Field Selecting of Seed Cotton.—(Figs. 27 and 28). The chief

Fig. 27.—This Alabama student cleared $127 on his project with two acres of cotton while attending high school. (H. A. Savage.)

Fig. 28.—These South Carolina students realized the importance of planting pedigreed cotton-seed. Dividing the lot of seed. (L. M. Banknight.)

points to be considered in selecting seed for cotton in the field before picking the main crop are the following:

Prolificacy, number of bolls to the plant.
Size of bolls, and perfect development.
Storm resistance or degree of opening of bolls.
Earliness.
Short internodes.
Number of side limbs or branches.
Length of lint, and uniformity of length.
Trueness to variety.
Large proportion of lint to seed.
Freedom from wilt, rust, boll-rot or other disease.

Students should practice the field selection of seed cotton with the points of this score card clearly in mind. The more practice they get in this the more skill they will attain. They should become so proficient as not to need to be questioned on the points during the operation.

Field Selection of Seed Wheat.—In wheat breeding it is possible to find certain heads of wheat that are superior to others. It is practical for a few seed breeders in each county to improve the wheat of the region by careful selection of individual heads. The yield can thus be increased in quality and quantity.

In practice it is best for all wheat growers who intend to save their own seed wheat to go to those parts of the field where the

heads are best filled, where the grain is mature, where the ripening is even, where the height of stalks is uniformly good; here cut the grain and save it separately for seed purposes. The seed wheat may be run through a seed threshing machine before the main crop is threshed.

Where individual heads are to be selected, as in wheat breeding, keep the following points in mind:

Select large, well-filled heads.

Stalks that are strong and support their heads well.

Plants that are well tillered or stooled; the larger the number of plants to the stalk the better.

Wheat true to variety.

Kernels plump and uniformly mature.

Disease resistance and plants free from rust and smut.

In wheat-growing regions it is well to let students practice the selection of individual heads until they become skilful in the operation. There is practically as great a possibility of improving wheat and other small grains by field selection as there is of improving the yield of corn by this method.

Skill in Harvesting.—(Fig. 25.) Running of grain binders, corn harvesters, mowers, and performing similar cropping operations should be practiced enough by students under instruction to make them skilful in all the details. In running a corn binder the operator should become skilful enough to avoid troubles regarding knives pulling the stubble from the ground, clogging of the carrier chains, failure to tie the bundles, failure to throw or properly carry the bundles, or unnecessary dulling of knives by too low cutting.

In running a grain binder the operator must be able to make the machine work well on both level and hilly ground; he must quickly adjust it to high and low grain if the stand be uneven; he must know conditions which will make the apron work well under all circumstances; he must carefully adjust the "butter" to suit different heights of grain; he must be a good judge of maturity of grain; he must understand the faults of the knotter; he should govern the rate of driving to obtain uniformly even results with his machine.

Skill in Hay Making.—The novice has admiration for the skilful hay maker. To obtain skill one must give attention to a number of points, chief among which are the following: Judging maturity of crop to be cut; weather conditions; facilities for curing; time in

which the kind of crop may be expected to cure most rapidly; effects of dew or showers on the particular crop; conditions in which the crop can best stand these, whether in swath or in shock; best conditions for handling to prevent loss of leaves; special equipment required for particular crops or seasons, as hay caps, and drying frames; degree of moisture (outside or internal moisture) allowable for satisfactory curing in shock, stack, or mow; what to do in case of heating; judging degree of heating allowable without injury; estimating weight of hay, loose and settled. More will be said

Fig. 29.—These Louisiana students learn to select seed corn by careful laboratory study. (P. L. Guilbeau.)

regarding skill in operation of machinery under the subject of farm mechanics.

Skill in Judging Products.—A successful farmer cannot be too skilful in judging the products of his farm. He should know the market requirements and the market grades of his crops.

Many exercises in judging field-crop products should be conducted at the school or at homes when products are harvested before they are marketed. Use score cards for each of the crops so far as they are available. Learn to know the market grades of wheat, corn (Figs. 29 and 30), potatoes, oats, barley, rye, clover seeds, grass seeds, alfalfa, timothy, clover hay, other kinds of hay, and indeed all market crops.[3]

[3] See Montgomery's "Productive Farm Crops" and other books giving market grades of different products.

Practice in judging the leading crops of the region will make students skilful in grading the products. For example, if hay is a common market crop for the region, it should be judged frequently and abundantly. Grading of corn is likely to be an important exercise throughout the region where corn is grown. Judge cotton in regions where cotton is sold. Judge tobacco if that is the important crop of the locality. Grading of wheat should be repeated over and over until the students are as skilful and rapid as the expert. If this be done, there will be less disappointment when farmers take their products to market.

General Equipment.—Use the apparatus from the science department so far as it is available for the work in hand. There are

Fig. 30.—Having studied the selection of seed corn, these students have prepared their ten-ear samples for a judging contest and show.

lenses, microscope, chemicals, and a number of other articles of equipment in the science departments that will be useful in lessons with crops.

The laboratory where the work in agronomy is to be done should be provided with work tables, sink, running water, cases, containers for illustrative material, cupboards with glass doors with materials that should be conspicuous, and cupboards with wood doors for other articles. These should contain drawers and shelves.

Storage of Agronomy Materials.[4]—The laboratory should be equipped with mouse-proof cupboards or a mouse-proof room. This is very important for the storage of corn, grain heads, grass heads, sorghum, kafir, and other materials which are likely to be attacked by mice and rats.

If the mouse-proof cupboard is provided, it should have some drawers lined with zinc, galvanized iron, or with hardware wire cloth.

[4] See also Chapter XV.

There should be plenty of room on the shelves for corn trays, each containing a sample of ten ears. Enough of these trays should be provided for class use.

A large mouse-proof cupboard can be easily constructed by a carpenter if plans are furnished him. If the cupboard is to be built stationary in the corner of the laboratory, the corner should first be covered with metal or wire cloth. The cupboard can then be constructed and lined with the mouse-proof material. After lining, the shelves and drawers can be put in, and metal-lined doors should be made to fit very snugly.

If such a cupboard is constructed carefully, it can be made nearly air-tight by having molding over the edges of the doors. This feature will make the cupboard suitable for fumigation with carbon bisulfide or with hydrocyanic acid gas. This provision will make it possible to store materials through the warm season and destroy grain moths which would otherwise ruin much of the collection.

Arrangement of Room.[5]—If the recitation is to be conducted in the same room where laboratory work is performed, it is well to have the cupboards containing materials and apparatus along one side of the room, perhaps on the side opposite the windows or chief source of light. Arrange the work tables along the back half of the room, but allow passageways all around them. Suitable laboratory seats should be provided around these tables. In the front half of the room it is best to have the recitation seats, perhaps chairs with side arms; a blackboard and a good demonstration table; have sink and running water in it at the front of the room or at one side. The demonstration table should be boxed in below and contain drawers and compartments for such apparatus as is needed for demonstration during the recitation periods.

A separate laboratory is often possible and usually desirable. This of course would be found in colleges and perhaps is some normal and high schools. If the recitation room be separated from the laboratory, it is well to have in the recitation room suitable demonstration material, a suitable table, running water, blackboard, illustrative materials on shelves, curtain and stereopticon for illustrative purposes, sets of charts and chart holders, and perhaps one or two side tables for keeping demonstration exercises before the class for several days.[5]

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[5] See Chapter XV.

Container for Specimens.[6]—Get large and small galvanized iron cans with tops which cover over the can evenly. These should be provided for keeping supplies of small grains, corn, grass seeds, etc. These cans may be of several sizes; perhaps one-half peck, one peck, and two peck will suffice. Smaller cans may be used for soil specimens to be used in demonstrations and experiments. When used for grains, these cans have the advantage of keeping away both mice and grain moths. They are also suitable for use in fumigating materials infested with insects.

Large-mouthed bottles with glass stoppers or cork stoppers are valuable for keeping grain heads, grass heads, and other specimens which are to be shown frequently but not removed from the bottles for laboratory purposes. Small vials should be provided for seed specimens to be passed around or used by students in the laboratory while making comparisons with materials they are studying.

Laboratory containers and dishes are necessary for the study of samples of grains and seeds. Each student will need several of these and suitable dishes should be provided. Glazed paper bowls or trays may be purchased. These are rather durable and may be used a number of times. They have the added advantage of being inexpensive. Glass Petri dishes are suitable for a number of soils experiments but are rather expensive and easily broken. They are sometimes used, however, as seed containers on laboratory tables. Small tin pie pans and earthen flower saucers are also used by some schools. There should be grain-judging trays and corn-judging trays. These may be made of wood or metal.

Trays for small grains may consist of ordinary dining-room trays with pint tin cups or glass tumblers for holding the samples.

Vial trays may be made by boring holes half-way through a thick board. These holes are of a size to suit the diameter of the vials used. Such trays will facilitate the handling of samples of economic seeds, weed seeds, corn products, feed samples, fertilizer samples, and others. The size of bottles used in these trays may vary considerably from the smallest vials to bottles two inches in diameter if desired. These trays should be made in the school shop or laboratory. An expansion bit owned by the shop will be useful in making such trays.

Bottle racks may be made by boring holes through small strips used as shelves. These are arranged in tiers in racks resembling

[6] See Chapter XV.

large test-tube racks. One form of rack for holding milk-bottle samples is sold by agricultural laboratory supply houses. Such racks have advantages over the trays if the samples are to be on exhibition and are not to be handled by the students in laboratory exercises. Any long series of samples, as the various products from a flour mill, may be well arranged in a wall bottle rack.

Seed-corn crates, corn dryers, corn trees, and wire stretchers for seed corn are all needed.

Supply small tin cans of various sizes for use in various exercises with grains. A few cans or pans of standard measures, such as the dry quart, half peck, peck, half bushel, and bushel should be available for use.

Small boxes of uniform size are valuable in handling heads of grains as well as threshed samples. Pasteboard boxes of many sizes are always useful. Specimens of heads may be sewed to cardboards of black or other suitable colors. These are then pasted at the corners into the bottoms of the boxes. When such specimens are kept on exhibition they may be sprayed with an alcoholic solution of corrosive sublimate to keep away pests. The boxes may then be covered with glass fastened securely in place with passepartout binding.

Agronomy Apparatus.—A few important pieces of agronomy apparatus should be found in the high-school laboratory.

There should be one or more types of corn cleaners, wood or metal grain measures, scales for weighing grains and soils, standard seed testers (incubator type), or substitutes in the way of sawdust or sand boxes.

Illustrative Supplies in Agronomy.—The laboratory or classroom should contain types of corn, small grains, legumes, kafir, milo, grasses, weeds, buckwheat, flax, rice, cotton, millets, hemp, and other miscellaneous crops. All of these should be represented in several forms, as sheaf heads of the different types, entire plants, and as threshed samples. Fiber crops should be represented also by the products in different stages of preparation. Root and tuber crops may be represented by specimens preserved in two per cent formalin solution in glass jars.

The illustrative materials should include not only perfect specimens but also those attacked by insects and diseases.

Samples of roots of the various crops are often helpful in teaching methods of tillage and adaptation of the crops to soils. Such roots may be preserved in two per cent formalin.

The by-products of corn, wheat, oats, flax, cotton, and other manufactured articles should be shown.

There should be samples of any or all of the above crops, showing ranges in size, yields, abnormalities, effects of fertilizers, and effects of inoculation. Standard market grades of the leading grains should be available for comparative purposes in teaching these standards to students.

How to show illustrative samples without using too much space in the laboratory or class-room is a problem which each instructor will wish to solve in his own way. Suggestions regarding the showing of sheaf heads sewed on cards in the bottom of boxes covered with glass have already been given. Threshed samples, cleaned or uncleaned, diseased or uninjured, may be shown in bottles held in racks or attached by clips which are fastened to heavy pulp board hanging on the walls. Such bottle clips or holders may be purchased from laboratory supply houses. Standard sizes of pasteboard, *e.g.*, 22 by 28 inches, should be adopted by each school so that all the cards may easily be stored away from the dust when not needed.

Some schools have adopted the plan of attaching the pasteboards to wooden frames. They are then properly labeled on the edge of the frame and are stored by sliding them into grooves in a cabinet made for the purpose.

Consumable Supplies.—For labeling specimens in laboratory work as well as in permanent collections, there should be a supply of blank labels. Some of these will need to be on gummed paper. Others should be of wood, particularly for germination experiments, soil tests, etc. When wood labels are to be kept for some time in field experiments, they should be painted with a coat of white lead and oil. Labels of this kind written with soft black lead will be very durable. Sticks may be made smooth enough to serve such a purpose, or wood labels of the kind used in orchard work may be fastened to the sticks with soft wire. Metal labels will be useful in field experiments. They may be made of very soft tin, as pure tin or leaded tin. When very soft, names may be written on them with a hard stylus after the metal is tacked to a wooden stick or other support. These are somewhat more permanent than plain wooden labels.

In testing seeds and in similar exercises there should be available for use a supply of sphagnum moss, clean sharp sand, sawdust, and cloths for use with these materials.

There should be a supply of all available fertilizer materials which are to be used in mixing exercises. Aside from this there should be, of course, fertilizers for consumption in the actual growth of plants.

Spraying materials of all kinds should be available for exercises in learning to mix them and also for use in spraying out of doors.

Provide a supply of the chemicals which may be needed in any of the exercises. Formaldehyde for treatment of smut and sulfate of iron for spraying weeds are examples in this group.

Plant supplies for laboratory study should be provided in sufficient quantities. Have standard varieties as well as all local varieties of corn, small grains, grasses, legumes, and such other crops as are of importance locally. In some schools it would be well to supply for laboratory study the leading varieties of cotton in boll and gin samples of lint and seed. Flax and hemp should be available for study in different forms in the states most directly interested in the production of these crops. In regions where sugar beets or other root crops are of great importance supplies should be provided for laboratory study.

Sources of Plant Supplies.[7]—Samples of grains, grasses, legumes, and fiber crops may be obtained from agricultural laboratory supply houses, but usually it is much better to procure the local varieties at least from the school farm laboratory or trial grounds. Many of the samples can be secured from the homes of students or from other farms of the neighborhood. In some states the state experiment farm provides such materials for use of high schools and other schools teaching agriculture. Considerable forethought should be exercised in procuring these materials in advance. When they are most needed in the laboratory they may not be available in the field. Suggestions for preserving these materials have already been given.

Pictures for Use in Teaching.[8]—An abundant supply of pictures mounted on tough book-cover paper, perhaps gray in color, should be collected in every school. A suitable size of mounting paper for many of the pictures may be such that they can be easily filed in a common letter-filing cabinet. Here they may be arranged according to subject matter and suitable guide cards may be provided.

Another size which will be found very useful for large pictures

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[7] See Chapter XV and Appendix.

[8] See Chapters XV and XVI, and Appendix.

is 22 by 28 inches. The pictures may be mounted so that the cards stand with the longest dimension vertical when in use. Perhaps several pictures may be mounted on these mounting sheets. The sheets should be made of heavy material, such as stiff cardboard. If eyelets are placed in the ends of the cards, several cards can be quickly hung together in chains from picture moldings or from other supports on the wall. The cards, when not in use, may be kept flat in shallow drawers made for the purpose.

Proper lettering should always accompany the mounted pictures. In some cases a mere legend under the pictures is sufficient, but on the large cards it is well to have some leading headlines, as on charts, to emphasize certain points or lessons to be learned from the pictures. When this is done the pictures are more suitable for use in extension work, such as community meetings, farmers' institutes, exhibitions.

Sources of Pictures for Mounting.[9]—Secure pictures of all crops, method of production, cultivation, harvesting, storing, marketing, combating enemies, etc. These may be cut from catalogues, agricultural journals, literature published by machine companies, fertilizer companies, seed houses, and manufacturers. Photographs may be taken first-hand by students and instructors and may be secured by exchange or donations from other schools, experiment stations, demonstration agents, special agricultural agents of commercial houses, banks and railroads, and others. The wide-awake teacher of agriculture will find abundant material for illustrative purposes to teach the many lessons that are most easily taught by means of pictures. Frequent use of such material will prove of great value in class-room instruction.

An indexing system for pictures may be easily established so that when pictures are removed from the files they may be easily replaced by students or by clerks who become familiar with the key system in use. The Dewey decimal system, or some modification of it, is perhaps most easily adapted to this purpose.[10]

Moving Picture Films.—Visualizing operations are of great benefit in teaching methods of various agricultural projects. Films are now being made by a number of companies for use in agricultural instruction. The preparation of fields for planting, cleaning

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[9] See Chapter XV and Appendix.
[10] See Chapter XVII and Appendix.

grain, tillage operations, selecting seed corn, methods of harvesting grain crops, hay making, harvesting and marketing potatoes—these are all good subjects for agronomy films.[11]

Local Subjects for Photographs and Lantern Slides.[11]—Every school will find it valuable to produce lantern slides of local subjects. To be able to give the name of the grower of the certain crop that is being shown, or certain soil treatments made by a particular farmer in the county, will aid materially in the teaching. The influence of one farmer over another and the effect of local "color" in a set of slides is important.

Take photographs of the effects of certain treatments of soil, such as a contrast between liming and no liming with clover; the effect of certain fertilizers on crops grown by most farmers in the community; the effect of inoculation contrasted with no inoculation. If possible, find an opportunity to take photographs where certain special treatments are of benefit. When certain farmers have made a fine preparation of the soil before sowing a crop, photograph that and let other farmers see their good example. Take pictures of farmers treating their seed grain to prevent smut; the treatment of potatoes for scab; the fanning of grain to cull out weed seeds; cutting potatoes; special methods of saving seed corn from rats and weevils.

Making Local Films.[11]—In the field of agricultural instruction there is need for films illustrating skilful operations. When opportunity offers, agricultural colleges, high schools with departments of agriculture, and others should equip themselves, either temporarily or otherwise, with film-taking machines. Produce films showing processes in preparing soils for crops; adjusting planting machines; cleaning grain; cultivators; planting potatoes and corn; drilling grain; hand sowing; use of hand seeders; spreading fertilizers; cutting and raking hay; making shocks; use of hay caps, with methods of fastening them on; methods of testing for dryness of hay; the waste of leaves; use of hay forks and hay carriers; mowing away hay; steps in harvesting grain, including the skill in operation of binder; operation of threshing machine with special attention to prevention of losses of grain, and thorough threshing.

When such films are taken they can easily be sold to manufacturers of positive films for at least enough to cover the cost of taking and making your own set of positives.

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[11] See Chapter XVI and Appendix.

Field Crop Machinery.[12]—In teaching the work in field crops have available for illustration and for use such small machines as seeders, hay forks, pumps, eveners, and hay cutters. Have important parts of machines, as planter boxes, sections of disk harrows and plows, rolling colters and other colters for plow beams, and bundle-tying devices from binders. Have models of silos, eveners, and other hitching devices.

If possible, large entire machines may be kept in suitable places at the school. Classes may visit dealers or machines may be brought from dealers to the school. On neighboring farms study the operation of such machines as manure spreaders, plows, tractors, silage cutters, binders, cultivators, and diggers.

Field-crop work in rural schools should be based largely upon the practices in the community. These practices may be those of the students and of their parents and their neighbors. Try to link the instruction closely to the operations themselves. Crops that are raised and the neighborhood practices with certain crops should be the basis for the work in rural schools. Suit the study to the season. For those times of year when seed corn should be selected in the fields let the lessons in school be upon that kind of work. In the winter when seed testing, grinding of feeds, marketing of products, selection of fertilizers, and similar operations are in progress, the school should take these for its subject matter.

In the rural school it is important that the student learn a few things well. Those field crops which are grown by all or nearly all the farmers of the region should be studied first and the best methods learned. Bad processes in the production of these crops should be condemned and better methods put in their places. The diseases and insects affecting these crops and methods of controlling them should be studied thoroughly. Do not expect students in rural schools to learn all there is to be known regarding all crops. Leave this to the high-school students or college students. It is better to know what to do and how to do it with reference to a few leading crops than to study the history, development and other nonvocational features regarding the crops.

Field-Crop Work for Pupils in Town Grades.—There are elementary lessons with farm crops which pupils in grades below high school may study with profit. Many studies relating to corn, wheat, and other common crops may be made from bulletins, from specimens themselves, from geographies, and from laboratory exercises

[12] See Chapter XV.

and field trips. After students have performed laboratory exercises in testing seeds, examining for impurities, or treating grain for smut, and potatoes for scab, they should base other lessons in their school work upon these exercises. If they take trips to nearby places to study methods of growing, handling, or selling certain crops, they should write up these trips, base arithmetic work upon the problems involved, form groups of spelling words, and have lessons in drawing and reading on such topics.

Short Courses with Field Crops.—The most important money crops of the region should form the basis for study in short courses, whether these courses be for a week or two or for a number of weeks. If it has been shown by some trials that certain new crops would be profitable in the region, these new crops may be considered in short courses. Let the instructors be chosen from among those who have had the best experience with such crops. They should teach largely from practical experience, and should base the lessons on specimens, materials, exercises, field trips, and practical work. Teach experiences rather than merely principles. Have a few night meetings and start debates, selecting topics from some of the lists in this book (see index). (See also suggestions for short-course work in Chapters VI to XII.)

Things to Discover in Field-Crop Work.—There are a number of things which would benefit each student by discovering for himself instead of being told directly. He may often learn a lesson better by finding out the answer from nature. A number of things which the pupil should discover are here suggested: (1) Does the soil on my farm need to be inoculated for certain new legumes? (2) Should my farm be limed for the growing of clover or alfalfa? (3) Should I sow alfalfa in August or in spring? (4) Would there be any objection to growing corn on a certain field two years in succession? (5) Would it be better to plan a short rotation or a long rotation for my farm? (6) What plants should I grow in a mixture for a pasture on my farm? (7) On my light soils what crops would make the best rotation for pig pastures?

Field-Crop Discussions.[13]—If students live on farms, they should be encouraged to discuss at home topics which have been suggested at school. Field crops are always of importance on farms. These will be subjects under discussion and new phases regarding them will not be difficult to introduce. Discuss plans for changing the rotation system on the farm. Discuss troubles with

[13] See topic for debate, Chapter XI.

certain crops of the preceding season and make plans if possible to avoid these troubles. Discuss the advisability of starting some of the new crops which have been suggested at school.

Teachers of agriculture may suggest such topics as these and ask for reports by pupils from parents and neighbors as to the trend of the discussions. Many topics may be suggested by going over the answers to surveys made previously.

Things to Observe in Field-Crop Work.—Observations on plants and crops add much to the training of young people. They should be taught to make many observations regarding the field crops on their farms. A few points to observe are mentioned here:

1. Note the kind of weather when pollen of corn is scattering and see that the silks of the corn are dry or in condition to receive pollen.
2. Observe the time required for the germination of any field crop after date of planting. Make memoranda of the moisture conditions of the soil at the time.
3. Note how long after blossoming the small grain requires for maturity of the crop. This will give a guide to the harvest date after blossoming is observed.
4. Observe how long a field of corn planted for roasting ears remains in marketable condition.
5. How soon after blossoming time of Irish potatoes may the early crop be harvested.
6. Observe the differences in young growth of small grains and learn to know how to tell them apart in that stage.
7. Learn to detect by close observation the first signs in newly planted fields of damage from such enemies as cutworms, gophers, blackbirds and crows.

Things to do in Field-Crop Work.—Doing things well should be the aim of all students. Instructors should teach students to do the work with field crops as carefully and accurately as they can. Teach them in drilling grain to see that the drill is working well and that no section fails to do its work. Teach them to skip no place between trips of the drill. Teach them in seeding fields with clover, alfalfa, or other small seeds to sow half east-and-west and half north-and-south, *i.e.*, to cross the field with part of the seeding to secure a more even distribution of seed. Teach them to plow fields chiefly by back-furrowing rather than by leaving a dead furrow in the middle. Teach them how to make moldboards of plows scour well. Teach them how to judge the ripeness of hay crops and grain crops. Teach them how to cure hay well. Teach them how to handle special hay crops without loss of many leaves.

Reference Books on Field Crops.[14]—Be sure to have on the reference shelves all of the available books relating to field crops

[14] See Chapter XVII and Appendix.

in general and also books relating to special crops. The latter will be of great value to students in making studies for their home project work. There are special books on small grains, others on grasses, others on legumes, others on alfalfa, others on potatoes. The first volume of Bailey's Cyclopedia of Agriculture will be of much use. See if there are any special crop books especially valuable to your own state.

Field-Crop Bulletins.[15]—Numerous farmers' bulletins relating directly or indirectly to field crops may be obtained free of cost. Obtain also many of the division publications from the United States Department of Agriculture. Obtain the special bulletins from state agricultural boards of the different states and also the many bulletins relating to field crops from the different experiment stations. First, write to all of those in your section of the country. After classifying these, obtain others from leading stations in other states. Remember that the more special bulletins you can obtain the better your students can make their project studies.

Field-Crop Journals.[15]—All general farm papers are devoted as much to field crops as to any other department of agriculture. First, obtain sample copies of those which you think would meet the needs of the students in your region. After examining these sample copies, subscribe for those which you find best suited to the needs in your locality.

Send for catalogues of all seed houses that are well located for your section of the country. Some of these frequently issue price lists of field seeds. Have the name of the school placed on mailing lists to receive such prices regularly. They will be handy for use in many problems which arise in project studies and other work in vocational agriculture.

EXERCISES

1. Make an outline plan for a field trip in the study of one or more of the leading crops in your state.
2. Revise the list of unit subjects for survey, given in this chapter, so that it will be more suitable for your state.
3. Make an outline for an agronomy survey on one of the leading crops of your state modeled after the potato survey given in this chapter.
4. Make a full sized chart useful in farmers' meetings, or in the class-room, using your best ingenuity for originality.
5. Conduct one or more contests with students in teaching skill in plowing, disking, drilling, selecting seed corn, etc.
6. Conduct judging contests with students.

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[15] See Chapter XVII and Appendix.

7. Obtain catalogues of agronomy materials and make up a list of equipment, with cost for each item.

8. Draw a plan of class-room with laboratory tables and equipment in the same room.

9. Collect a number of pictures useful in teaching field crops. Classify these pictures and mount them, using the suggestions given.

10. Make a list of five suitable topics for debates concerning field crops.

QUESTIONS

1. Make a list of the most important crops in your state, which should be included in teaching the subject of field crops to high-school students.
2. Make a list of rather new crops which should be considered at least in some sections of the state. What would be the advantage of having students understand the details of raising these new crops?
3. Give a reason why you would prefer to teach the subject of field crops before you teach animal husbandry to high-school students.
4. Tell how to apply the topical method to an assignment and recitation on some particular crop.
5. How would you relate the topics in the class recitation to the project work of the students?
6. Suggest a list of illustrative material for use in the subject of small grains; in the study of corn; in the study of cotton, or tobacco.
7. Suggest a number of class-room demonstrations to aid in the study of sweet potatoes; of Irish potatoes.
8. Suggest laboratory exercises suitable to accompany the study of these two crops.
9. Give a list of outdoor exercises in agronomy, increasing, if possible, the list given in this chapter.
10. Why should a field trip be planned well before it is undertaken?
11. Why should the students be required to follow such a plan?
12. Why should the student make notes of the answers to questions at the farm where any crop is being studied?
13. Make a list of twenty-five kinds of home projects for profit in the field of agronomy, suitable for students to pursue.
14. Classify twenty-five projects somewhat as they are classified in this chapter.
15. Mention the chief topics that should be included in a small-unit agronomy survey.
16. How can you make use of the information gained after survey cards are filled? How would you have this information summarized?
17. Suggest subjects for several new agronomy charts.
18. Mention a number of topics in agronomy in which students would be required to gain skill.
19. Give the points to be considered in judging a plowing contest.
20. How could you judge the work of a student in disking? In drilling?
21. What points should be included in a score card used to judge a contest in field selection of corn?
22. Why should cotton seed be selected in the field?
23. Give points to be observed in field selection of seed wheat.
24. What skill can be exercised in harvesting small grains?
25. Mention a number of agronomy topics in which skill in judging may be used.
26. Give a list of agronomy materials which may be stored for class use and tell how to store them.
27. Tell how to make a mouse-proof closet.
28. Mention suitable containers for specimens; for samples of grains and seeds.
29. Where would you get illustrations for use in teaching agronomy?

30. Give suggestions regarding methods of showing illustrative samples.
31. Mention a number of consumable supplies which you would need in teaching agronomy by laboratory methods.
32. Mention a number of sources of pictures useful in teaching agronomy.
33. How would you arrange and mount such pictures?
34. Mention suitable subjects for moving picture films in agronomy.
35. What local scenes would be suitable for photographs and lantern slides?
36. What machines would you want for teaching a class the implements used in field work?
37. Suggest suitable field-crop work for pupils in town grades.
38. Give a list of things to discover in studying agronomy.
39. How would you start discussions among students and parents in studying field crops?
40. Give a list of things to observe in field-crop work.
41. Mention ten suitable field-crop books to place on the reference shelves.

CHAPTER VI

HOW TO TEACH ANIMAL HUSBANDRY

"The specific aim of the work in Animal Husbandry is to enable young people to obtain such a knowledge of the characteristics, breeding, feeding, care and management, and marketing of the domestic animals commonly raised for profit in that region as will prepare them for success in livestock farming."—Report of Committee on Agriculture of the N. E. A. Commission on Reorganization of Secondary Education.

It is the aim of this chapter to call attention to such special methods as will enable instructors to most successfully lead their students to a lucid understanding of the subject of animal husbandry. There are many such methods used by certain schools that are not known by others. The suggestions here given may lead instructors who are seeking the best methods of teaching animal husbandry to devise and adapt all of these that will suit their own local conditions.

Special Methods in Animal Husbandry.—There is so much valuable material to aid in teaching animal husbandry that we ought to lay down this principle at the very outset: "Always have some illustrative material available for every lesson." There may be a few occasions for making exceptions to this rule, but the exceptions should be as few as possible. Use animals that are found in the neighborhood to illustrate the lessons being taught (Fig. 31). Never conclude that animals are to be used for judging purposes only. They may be used in showing the location of parts, location of diseases, points of unsoundness, studies in animal mechanics, heredity in breeding, gaits or action, effects of feeds, effects of special treatment or management, treatment of diseases, tests for diseases, prevention of diseases, and in other ways.

Content of Animal Husbandry.[1]—In high schools the subject of animal husbandry usually includes a study of all the types of farm animals, horses, cattle, sheep, hogs, and poultry. Both the dairy and beef types (Fig. 32) of cattle are usually included. If special study is given later in the course to dairying or to special poultry husbandry, these should be in addition to the general introductory course. If dairying and poultry husbandry are to be repeated later, the small proportion of attention in the general

[1] See N. E. A. Commission on Revision, Agriculture Report, U. S. Bu. of Ed.

animal husbandry course will not be in vain. Good outlines of subject matter in animal husbandry may be found in the textbooks. As several of these are usually found in the libraries of most schools, it is needless to repeat their tables of contents here.

The way in which the topics are to be considered should be decided by the instructor and students after making some local surveys and carefully studying local conditions. It should never be concluded that the consideration of topics should be in the order given in any particular textbook. No author of a textbook can arrange the subject matter to suit the local conditions in all parts of

FIG. 31.—Group of students in animal husbandry being taught to judge farm horses. (H. N. Loomis, Northampton, Mass.)

the country. The instructor should have such intimate knowledge of the local conditions as to be able to decide for himself the topics to be considered first.

Emphasis should be placed on those phases of animal husbandry which are of most vital importance to the region. If horse husbandry is of great importance locally, let that be considered early in the course and let special emphasis be given to it. In some regions mule production might be likewise important. Beef cattle should come up for most important consideration in some sections. In still other places swine husbandry is the most important. The sheep industry is prominent in some regions and not in others. Let the instructor and the class decide together what special phases of animal husbandry need consideration most. In some cases there

is an advisory committee, or member, in the community who also should be consulted on this point. When season makes any important difference, remember to make the topic timely.

Equipment for Teaching Animal Husbandry.—Schools vary

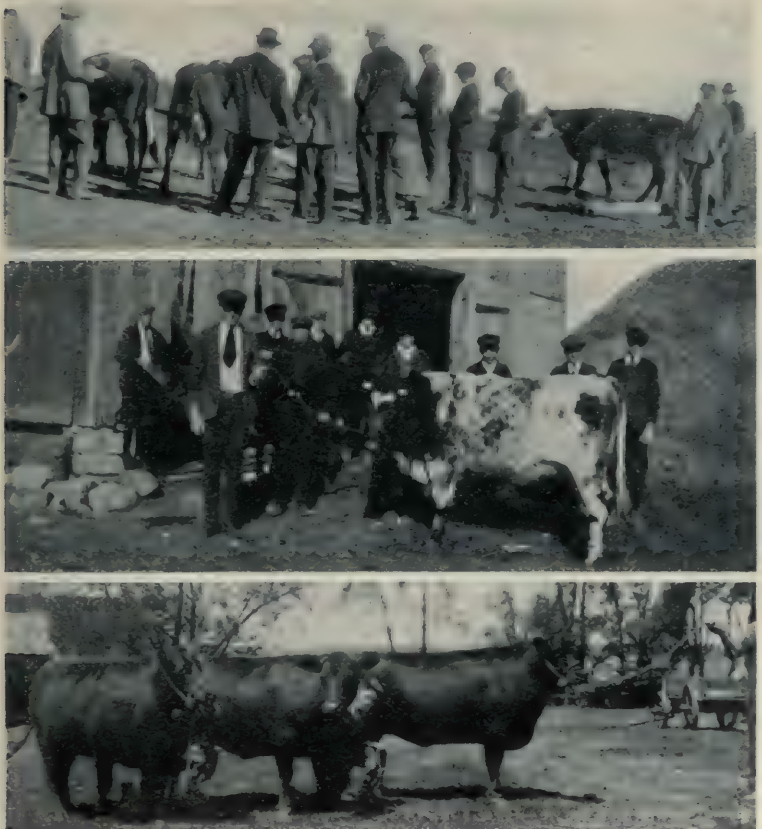

FIG. 32.—Judging and scoring beef cattle. Students should become familiar with all the breeds of the region. Study utility types and show types. (W. V. Longley, Minn., and E. O. Bolender, Ohio.)

widely in their equipment for teaching animal husbandry. When the school owns only a few animals and these are restricted to only a few types, material for instruction must be found in the region. Do not omit teaching concretely for lack of sufficient illustrative equipment.

In the best-equipped schools the different types of horses are kept for the sake of teaching students the nature of all of these types. These schools are likewise equipped with different breeds of beef and dairy cattle, the leading breeds of hogs, several breeds of sheep, and a number of varieties of poultry. Buildings of several types for the housing of each of these kinds of animals are sometimes found (see page 121).

Schools having such superior equipment as this have greater responsibility than others because of the large amount of money invested. From such schools more is usually expected in the way of practical instruction. On the other hand, instructors in schools which have little or almost none of the equipment just mentioned for the teaching of animal husbandry should feel the need of obtaining the use of such equipment in the region. The students may be taken to the animals or the animals may be brought to the school. They should never allow the absence of such equipment to stand in the way of practical instruction. Make contrasts with the good and the bad as they are found in the region.

The cost of maintenance of expensive animals owned by the school is an important consideration. Many high schools have decided not to purchase expensive pure-bred animals because of the cost of maintenance. Unless these are to be kept in large enough numbers to be good sources of income it is perhaps bad management to have them kept at great financial outlay by the school.

In some institutions it is advisable for the school to own pure-bred sires for improvement of livestock purposes in the community. The school may be the center of a community breeding circle with beef cattle and other types of livestock. In all such cases the maintenance of animals should be provided by the rules of the breeding association. The extra instruction which the students may get because of the presence of these animals will be a clear gain to the school.

Class Work in Animal Husbandry.—The suggestion has already been made that the class work in animal husbandry should be practical and concrete by being well illustrated with the use of animals. In making lesson assignments individual students should be given such topics as will cause them to make use of animals in presenting the topics to the class. Of course they should be required to do reading from textbooks, reference books and bulletins in preparing their topics. These should be closely associated with the projects

which some members of the class are pursuing. A wide range of topics closely related to the same general phase of the subject may be assigned to different members of the class. Thus studies and reports from different angles of vision will be developed. Remember that students will always work better, show greater interest, and report with greater enthusiasm if they have been making researches which are not assigned to other members of the class.

FIG. 33.—In home project work the student, father, and instructor meet on the farm to study the details of the enterprise. Animals should be frequently weighed and records kept. (T. G. Brown, Wis., and S. R. S., U. S. D. A.)

The attitude of the instructor in this topic method of recitation is that of a masterful director. He has to exhibit his skill in wise lesson assignments. He will show his knowledge of the literature of the subject by concrete references. He must discriminate closely between good and poor reports on the various topics by students. If, for example, a student gets two breeds of animals confused, or if he gets two points of animals mixed, or two blemishes or diseases confounded, he should be promptly corrected and other students should be called upon to straighten out the difficulty.

Base the class work on the home project work of students enough to keep the interest of the whole class centered on these projects (Figs. 33 and 34).

Review Work.[2]—All class work should be frequently reviewed. Perhaps a few minutes at the beginning of each recitation should

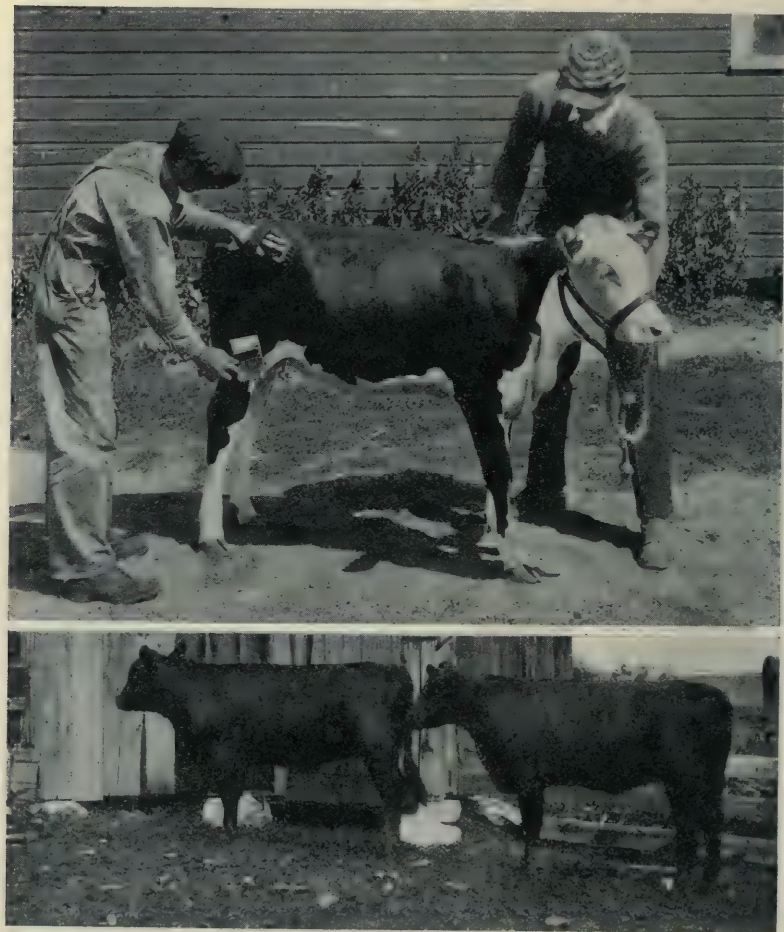

FIG. 34.—These students are learning to prepare baby beef for market. The calves in the lower view were fed for 110 days as a group project by the animal husbandry class of an Iowa high school and gained three pounds and one pound per day, respectively. (Upper, S. R. S., U. S. D. A. Lower, R. M. Vifquain.)

be used to review the main points of the preceding lesson. This will aid in bringing to the minds of the students the points which

[2] See Chapter IV.

the instructor considers most important. It will also fix in the minds of all those points which were studied and reported by individuals only. The use of review questions written on the blackboard or given to the class on mimeographed sheets from time to time will aid materially in all of these points.

Animal Husbandry Laboratory Work.—Those schools which have some equipment in animal husbandry will find it possible to

FIG. 35.—These groups of students from high schools have gone to neighborhood farms to study horses of superior quality. The horse owners seem as interested as are the boys. (Allen Aldrich and W. P. Dyer.)

conduct considerable laboratory work at the school. All the work in dairying which is familiar to the instructor may be considered as animal husbandry laboratory work (Chapter VII). The feeding and care of animals in barns, in feed lots, in hospital stalls, are all valuable methods of instruction.

Judging animals is a common form of laboratory practice (Figs. 31 and 35). Examining animals for unsoundness (Fig. 45), detecting the age of animals, comparing them in dispositions,

temperaments, gaits, conformation, and suitability for certain purposes, are all good practices for students.

Many feeding experiments are outlined in two manuals now on the market.[3]

Important exercises in feeding should include the mixing of concentrates for dairy cows, for beef cattle, for poultry, for hogs, or

Fig. 36.

Fig. 37.

Fig. 38.

Fig. 39.

Figs. 36–39.—Four methods of feeding pigs in boys' project work. Fig. 36, dry lot with corn and slop. Fig. 37, home-made feed hoppers and rape pasture in Tennessee. Fig. 38, green feed supplied in small pen by soiling method, Wisconsin. Fig. 39, grain to supplement pasture. (Last three from S. R. S., U. S. D. A.)

other animals, using the feeds which are common in the region or which are easily available. Dry mashes and scratch feeds for poultry should be included (Chapter VIII). Conduct experiments in judging hays of the same plants by score cards and by comparison. Visit hay mows and stacks and calculate the amounts of hay in them. Make comparative studies of straw in stacks and in bales. Make trips to silos and study the silage with reference to fineness,

[3] Woll's "Feed Manual and Notebook" and Savage's "Feeds and Feeding Manual."

palatability for animals, keeping qualities, moisture, and feeding value. Make calculations of the amount of silage in silos. Visit feed markets and study the different types of feeds, market prices, guaranteed composition of each, and determine which are most economical for use with different types of livestock. Make laboratory tests for adulteration of concentrates, as in linseed meal, cottonseed meal, molasses feeds, poultry and dairy mixtures. Examine feeds which are likely to contain large amounts of indigestible materials, such as corn-and-cob meal, buckwheat bran, and rice bran. Determine the percentage of hulls in whole oats and in ground oats. Visit mills and factories where by-products are prepared for

Fig. 40.—Hog cholera vaccination demonstration on high school campus, at Sebastopol, Calif. The grammar school boys came to witness the demonstration. (H. I. Schnabel.)

feeding purposes. Study the various by-products while they are being prepared for the market. These should include if possible the various wheat, oat, and barley products, peanut products, linseed meal, cottonseed meal, soybean and velvet bean meal, alfalfa meal, cocoanut meal, or any others available in the region. It may be possible to visit abattoirs or packing plants, and learn the methods of preparing blood meal, tankage, meat scraps, and other products. In the study of the effects and uses of feeds trips should be made to particular farms selected for special purposes, such as: the feeds of certain rations in calf raising; unusual rations being fed to dairy cows; the feeding of cows for official tests; stations and substations where special feeding experiments are being conducted;

the use of soiling crops for dairy cows; the study of special pastures, as rape, alfalfa; the use of special rations in fattening hogs, fattening steers, feeding market pigs, show animals, and breeding animals.

Laboratory Work with Horses and Mules.—The study of horses and mules will be made more interesting and more valuable by a number of exercises and trips (Fig. 35). If mule growing is important in the region, visit the barns where jacks are kept and study the methods used in their care and management, prices for service, number of animals bred in a season, the percentage of live

FIG. 41.—Boys docking a lamb by the hot-iron method. (E. E. Knudson, Wyoming.)

mule colts, and the profits, if any, derived from the keeping of jacks. Studies in heredity may be made by comparing the types of various jacks and mares with their offspring.

In regions where valuable stallions are kept, make trips to their stables and make similar studies.

Visit farms where large numbers of work horses or mules are kept and study methods of handling them, what rules for teamsters are posted in barns or otherwise enforced by managers. What care is exercised with work animals when returned from work, and what care is given to the harness? What types of animals are used on

such large farms, light or heavy? If different farms vary in regard to these points, find the reasons for these differences. Visit the barns of veterinarians and study animals under treatment for various troubles, as fractures of bones, dental troubles, or any common or uncommon ailment. Become familiar with the symptoms of various troubles and the treatment being administered. If possible, have the veterinarian show his surgical instruments and explain or demonstrate their uses.

Another good exercise with animals of any kind is to obtain specimens of their parts from veterinarians, from farmers, or other owners. Hoofs and other parts of horses are obtainable from dead animals. Different types of hoofs should be collected for making comparative studies. Skulls showing different formations of teeth

Fig. 42.—Ohio students of sheep management. Practice in trimming feet on a farm near the school. (E. O. Bolender.)

or other characteristics are valuable. Flesh may be removed from bones by boiling in dilute caustic potash or lye.

Post-Mortem Studies.—When word is received of the death of an animal of any kind, the class should, if possible, visit the place and make a post-mortem examination to determine the cause of death. Directions for such work may be found in books relating to the diseases of farm animals, such as Craig's, Mayo's, and others.

Exercises in Swine Management.—Students should become familiar with the young and old, male and female animals of all the breeds of swine available. Visit them wherever they are kept and study their comparative sizes, rapidity of growth, size of litters, vigor, their prominent markings and other characteristics. Different methods of housing should be compared and criticized. Feeding systems and pastures should be studied carefully (Figs. 36-39).

Good exercises for students may be the making of hog cots, feeding troughs, feeding hoppers, oiling devices, concrete wallows, breeding floors, and shelters from intense sun and winter blasts. Also they should make breeding racks, pig creeps, and watering devices.

Exercises in the treatment of hogs to prevent cholera (Fig. 40) should be repeated several times by the students. Likewise there should be practice in the treatment of hogs for lice, worms, and other common ailments. Students should practice castration of pigs, the correction of ruptures, the removal of tusks of boars, and similar common operations.

It is sometimes good practice for students to prepare a bunch of

FIG. 43.—These Nebraska students, after studying lambs, stopped to have their picture taken.

pigs or other animals for exhibition. Begin a few weeks before fair time and give them feeds which will keep them in good condition and aid their appearance. Wash and brush the skin frequently and treat the coats with olive oil or other materials.

Exercises with Sheep.—Many lessons can be learned by taking trips to farms where sheep are kept. At lambing time, the special management of lambs and ewes to solve the numerous difficulties which arise should be studied and compared. What pasture rotations are practiced to control stomach worms? Compare methods of housing in winter and let this study include numbers kept in each flock; methods of feeding; kinds of racks used; what farmers are most careful in their separating of flocks of animals of different grades, as large from small, young from old, males from females, etc.

Let students practice docking (Fig. 41) washing, shearing, castrating, dipping, preparing fleeces for market, trimming feet (Fig. 42) and similar operations necessarily made by a good sheep husbandman (Fig. 43).

Practical Studies and Exercises with Cattle.—There are many ailments of cattle which should be studied in feed lots, or in their home barns. Learn to diagnose diseases and administer common remedies. Practice testing for tuberculosis, treatment to prevent black leg, castration of calves, clipping, washing, and otherwise preparing animals for show. Visit packing plants and study the methods of inspection used by government officials. Study the uses made of different parts of the carcass, the curing and preserving of meats of all kinds of animals.

While visiting the various farms where cattle are kept, investigate by talking with the owners and by careful observation of methods and results, the relation of type to purpose. Decide whether dairy type, beef type, or dual-purpose type are best in each particular case. Determine what disposal is made of the male calves of each type of animals kept in the neighborhood.

Determine cost of raising calves to the age of use for veal, to the age of use for baby beef, and to the age for use as breeding animals. The facts for this investigation should be obtained through visits to farms where accounts and records of the cost of production are kept.

Animal Husbandry at the School.—In regions where the farms are not well supplied with high-grade or pure-bred animals of different types, it may be advisable for the school to own such livestock. The school may thus be the center of instruction for the community as well as for the pupils. Farmers may be led to study the different types of animals and decide to start herds for themselves.

If work horses are kept at the school, they should be of the best type, and preferably they should be brood mares. If they are pure bred and the offspring are registered, the school may soon become a center for the introduction and distribution of good blood in the community. Students and instructors will find opportunity for using such animals for judging purposes, for comparison with native stock, for study of types and breeds, as well as for lessons in care and management, and prevention of diseases.

Community Surveys in Animal Husbandry.[4]—An instructor in

[4] Other suggestions for farm surveys are given in Chapters V, and VII to XII.

animal husbandry should be familiar with the conditions which prevail in the region. He should know what pure-bred animals are available for study. He should know what conditions for housing and care of animals are to be found on the various farms; what feeds are being used; what plans farmers may have for improving their herds, etc.

Community surveys are so easily conducted through the students of a school that they should be made frequently. No single survey should be extensive. Perhaps one may cover the subject of swine husbandry; another later may be devoted to horses; and others to beef cattle, sheep, and poultry.

A swine survey may be made on a standard card 5 x 8 inches. If the questions are printed, sufficient blank space may be left for the answering on the card if both sides of the card are to be used. If the questions are to be mimeographed, typewritten, or duplicated from handwriting with the hectograph, a larger card or sheet may be advisable.

The question card for the swine survey should include the following:

1. Name.
2. Location from school.
3. Size of farm.
4. Acres devoted to swine pasture.
5. Acres devoted to yards and buildings for swine.
6. Buildings.
7. Cost of buildings.
8. Number of pure-bred sows.
9. Name of breed.
10. Number of other brood sows.
11. Number and name of sire.
12. Number of pigs raised to weaning age during the year.
13. Are offspring registered?
14. At what ages are surplus animals sold for breeding purposes?
15. Prices.
16. At what age or weight are surplus animals killed and sold for meat?
17. Sanitary precautions.
18. Is meat cured and smoked?
19. Prices.
20. System of feeding sows with litters.
21. Annual cost on this farm.
22. System of feeding fattening animals.
23. Annual cost on this farm.
24. Treatment for lice.
25. Treatment for worms.
26. Treatment for cholera.
27. Other swine troubles on the farm.
28. Deaths and causes in the past year.
29. Kinds of wallows.
30. Pasture crops grown during the year.
31. Means of supplying mineral feeds.
32. Provisions for watering.

How to Use the Card.—After enough cards have been prepared either by printing them or otherwise multiplying them, students should be instructed regarding the method of answering the questions or giving the information desired. Go over the cards and show the students how to fill the blanks. Send one card to the

home of each farmer with the request that the information be supplied and the cards returned on a certain day.

After the cards have been returned, certain students may be assigned the task of tabulating the information received from the first seven points. Another group of students may be assigned another set of points, as from eight to nineteen, inclusive. Let another group of students tabulate the results of the information obtained regarding the feeding questions twenty to twenty-three. Another assignment may include the tabulation and adjustment of the information gained regarding the treatment of swine troubles of various kinds.

When all the information has been tabulated by different students, not only the instructor but the students will be rather familiar with the actual conditions prevailing in the community regarding all the points covered by the survey. They will have made comparisons regarding methods, equipment, results, etc. Assignments should be made to the class to criticize the methods of feeding as reported by certain swine growers. The income and profit may be calculated from the results reported, comparisons may be made regarding the keeping of graded or pure-bred swine as reported on the different cards. The benefits derived from pasturing may be shown if cards are properly filled.

The results of the survey may be taken as a guide for each of the future studies in swine husbandry. In the study of diseases, their prevention and treatment, much may be learned from the survey cards if the information is fully given. Lessons in marketing may be gained from the information on the cards. Calculations may be made regarding the profits from killing and curing meats on the farm.

Special inquiries may be made regarding any particular points which it is desired to study at the school. These may be given special answers if some of the students are conducting swine projects of their own, and details regarding conditions in the neighborhood are likely to add interest and information to the project studies. For example, it is well to know the amount of shrinkage in weight of carcasses during butchering, that is, comparing live weights with dressed weights. Some farmers may also be able to give information regarding the loss in weights of meat during curing in dry salt, in brine, and in smoking.

Other Animal Husbandry Surveys.—The preceding outline for the swine survey may be taken as a guide for conducting surveys

in other lines of animal husbandry. In preparing a set of questions for the survey it is well to have members of the class suggest questions along the different lines of inquiry. Every effort should be made to make the questions very concise, easily answered, and on the whole comprehensive. Never attempt to carry on two surveys at the same time. One is enough to frighten some of the farmers, and they will object to answering many of them at one time.

Some instructors have found it advisable even to divide the information wished regarding one kind of farm animal into several sets of questions, sent out at different times. Thus the questions regarding the numbers and breeds are separated by a week or more from those regarding diseases, or those regarding costs of marketing. The simpler the questionnaires the more complete the answers are likely to be.

Supplementary Aids in Teaching Animal Husbandry.—There are a number of good animal-husbandry charts which should be used in the teaching of the subject. The best are those which bring out well the points in the selection of animals. A chart containing poor pictures of the animals of different breeds is of little value in the teaching of the subject. Superior colored pictures can be obtained or enlarged photographs may be made or purchased. These can be used in making charts for use in the schools or they may be framed or mounted under glass with passepartout binding. Moving picture films of superior animals may be obtained from breed registry associations.[5]

There are a number of good stereoscopic views on animal husbandry which are worth having in the study room or in the laboratory. Get lists of these and select from them carefully. Lantern slides of animal husbandry subjects should be made from photographs taken in the vicinity if possible.[6] If not enough of this kind can be secured, others should be purchased to supplement the local ones. The best slides are those which show operations and methods rather than mere types and breeds.

Skeletons, plaster casts, and papier-maché models of various farm animals or organs of them are available and may be secured by schools able to purchase them. Bones, skulls, and jaws of animals are sometimes found or obtained from dead animals, and should be saved for instruction purposes. Hoofs of horses are valuable in showing the structure and uses of parts.

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[5] See Chapter XVI and Appendix.
[6] See Chapter XVI.

Specimens showing diseased glands or other parts of animals may be preserved in formaldehyde solution for ready reference and

Fig. 44.—In these projects plenty of good clover and grass pasture are used to keep the pigs growing well and their mothers in thrifty condition. (Upper, from P. L. Guilbeau, La. Lower from E. H. Thompson, Luther, Okla.)

use in classes and laboratory work. Get these at post-mortem examinations.

Animal Husbandry Apparatus.—Models to show draft may be

made by members of the class if not purchased from supply houses. Have measuring tapes, poles, and measuring sticks with slides for taking all measurements of animals in judging exercises.

Have samples of feed boxes, watering devices, oiling apparatus, sprayers, instruments for extracting teeth, treating bloat, castration, syringes, clinical thermometers, milk-fever outfits, hypodermic syringes and needles, and other simple veterinary instruments.

Each school should have a case containing first-aid outfits and common medicines. Have hanging in cases or attached to wall-boards such things as the following: Bridle bits of many types; head-stalls; dissected collars; dissected saddles; samples of braided manes and tails; samples of rope splices and knots; many types of curry-combs and brushes, and mane-combs and carders; samples of wool and mohair of all types. Have samples of stock feeds in glass bottles and jars so they may be ready for use in classes and laboratory work. Have ingredients of typical balanced rations.

Sciences Aid in Teaching Animal Husbandry.—The chief sciences which aid instructors of animal husbandry are: Chemistry, particularly that part which relates to feeds; veterinary science; human physiology; zoölogy, including biology of parasites; the principles of physics as relating to draft.

Animal husbandry in rural schools should be based chiefly on practices of the community and animals found in the community. Expensive equipment is usually impossible and unnecessary. Animals may be brought to the school without great difficulty. If, however, the classes can be taken to farms for studying swine, sheep, and other animals, near the end of the school day, they will be able to study many features of management and learn methods and operations practiced by owners.

Comparative judging of animals to teach the principles of selection may best be done on the home farms of the students or neighbors.

Lessons with Animals in School Grades.—Children below high school, either in the country or in villages or cities, can be given many valuable lessons which will interest them in animal husbandry and add greatly to their general intelligence. They can learn to know all the breeds of common animals about them. They should also know the general differences between types of horses, types of hogs, types of sheep, and types of cattle. They can learn to know uses of all animal products. Habits of animals should be studied regarding natural grazing, differences in digestive systems, sets of teeth,

and many other simple lessons largely founded upon common knowledge and observation.

Animal Husbandry Short Courses.—When high schools offer courses in animal husbandry they should base these courses upon surveys previously made in the region. These surveys should reveal the needs of the community. Let those particular phases which will meet the needs be emphasized strongly. Most other lines of livestock work may be omitted. Specialists should be secured who can best present the particular phases that are to be emphasized during the short course. The topics should be presented by means of demonstrations and with the best specimens of animals available to illustrate particular points. If, for example, the subject of common diseases of animals is being presented, there should be good examples of animals showing diseases. The same principle applies to all lessons in animal husbandry. Usually the students are attending for particular purposes and they should be able to secure from the short course all lessons they need to know.

In college short courses let those who know the needs of the state or section be the ones to designate the topics and divisions of the subjects that are to form the courses. Omit theories as far as possible. Include such principles as will make clear the reasons and practices recommended.

How to Teach a Lesson in Animal Husbandry.—Suppose the lesson assignment has previously been made on the general topic of hog pastures (Fig. 44). The different students may have been assigned such special phases of the topic as: Suitable pasture crops for early spring; suitable pasture crops for hot summer months; suitable pasture crops for fall and early winter; substitutes for pastures in winter seasons; hurdle and other fencing for temporary hog pastures; watering systems on temporary pastures. Different authors should have been cited for each of the assignments made. Let certain students be required to have ready to show to the class good pictures of the different pasture crops. So far as possible they should also be ready to show specimens of the pasture plants of the different seasons. Have these specimens fresh rather than dry mounts.

At the time of the recitation let the topics be taken up in the order suggested above. On the blackboard or on large sheets of paper let each student draw a series of pasture lots. In these lots write the names of the pasture crops for three or more seasons in rotation. The members of the class should learn the possibility and the problems involved in making a continuous pasturage system for

the growing seasons of the year. To help teach this, the value of pasturage for swine should be reviewed and impressed by questions from the instructor. Have specimens and pictures of the plants shown and let their relative values for pig feeding be discussed by members of the class. Special treatments for the management of certain kinds of pasture should be developed. Skilful questioning may be necessary. Students should be called upon to give examples for uses made of the different pasture plants in their observations and experiences.

When the topic of winter substitutes for pastures is up for consideration the question of how to raise winter litters of pigs on these substitutes may be developed. Show specimens of stored root crops, alfalfa hay, silage, and other winter substitutes.

If possible, let this recitation take place out of doors on a pig pasture. In that case a blackboard exercise may be omitted, as a field or lot on the land laboratory or farm will be much better.

Animal Husbandry Readings.—Let students be induced to read reports of animal husbandry conventions, fairs, tests of animals, contests of college and school judging teams, and other valuable matter which appears from time to time in magazines. Assignments may be made for the report of animal husbandry news and articles of interest from time to time. These reports may be made in connection with suitable topics in class recitation, or during trips of the class in the community.

Discoveries in Animal Husbandry.—Students should be aroused to the possibilities of learning new ways of doing things or making other discoveries along animal husbandry lines. Of course the points which they seem to discover may already be known by others. The mental action of the student, however, is none the less valuable. Read the discoveries suggested in the poultry chapter. Students should discover causes of lameness in animals; causes of sickness of any kind; methods of breaking colts; better methods of handling animals at various times and circumstances; what bits are best suited for horses under different circumstances; the remedies for misfitting harnesses and collars; the bad conditions of various animals although not sick; the best management of pigs, lambs, colts, and calves when newly born; how to make young animals love their keepers.

Animal Husbandry Discussions.[7]—Teach students to discuss

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[7] See topics for debate, Chapter XI.

animal husbandry topics at home among each other and among their neighbors. Several ways of doing this may be as follows:

(1) Arouse during class recitation discussions on topics which have two sides. (2) When such questions arise during recitations, tell them to think about them and discuss them further and bring the question up again at a later meeting. (3) Assign definite debates for future recitations; let two students be assigned as leaders of two sides of the question, and let them choose in turn their members of the class for the debate. (4) Have students ask parents regarding their experiences on certain animal husbandry topics about which there are differences of opinion. (5) Have parents questioned regarding their opinion as to certain animal husbandry practices by farmers in general and farmers of the neighborhood.

For these discussions such topics should be selected as will arouse interest in the phases of animal husbandry that should be stressed in the region. If pure-bred cattle or improved breeds of horses are to be encouraged, such topics may be open for discussion. For example, the question of owning pure-bred sires or using scrub animals may be started as a neighborhood debate. The practice of immunizing hogs against cholera may be started for a neighborhood discussion. There are many other important topics of local interest.

Observations in Animal Husbandry.—Numerous points for observation may be called up by instructors. Or students may volunteer their observations in animal husbandry at school. Suggest many things which will arouse students to be observing. A number of these are here given:

(1) Which way does a horse move his head in eating grass? (2) Which way does a cow move her head in eating grass? (3) How does a horse get up from lying down? (4) How does a cow get up from lying down? (5) What effect does dehorning have on the disposition of cattle? (6) What are the causes of nervous temperaments in cattle and horses? (7) What are some of the causes of balkyness in horses? (8) Are horses that are balky usually stubborn in other ways? (9) Are willing horses or lazy horses most often affected with curb? (10) Are colts more thrifty when allowed to follow with their work mothers or kept in paddocks during work hours? (11) Are heavy sows or light ones more successful in raising their litters? (12) Are hogs of bacon type or of lard type more successful in raising their litters? (13) Are twin lambs less thrifty than others?

Things to Do in Animal Husbandry.—Correct methods of performing many operations in animal husbandry should be instilled in the minds of students. One of the most important things is for them to learn system and regularity in the care of livestock of all kinds—regularity in feeding, regularity in watering, regularity in turning out to pasture, regularity in returning animals to the barn. They should learn properly to tie horses and colts so that they can-

not hurt themselves at night or other times. They should learn qualities of feed by actual practices so that animals will not be uneasy for want of feed and will not be injured by overfeeding. Learn to fit collars well. Learn to put on harnesses carefully, correctly, and rapidly. Learn to make young animals take the first milk after they are born. They should learn how to feed calves and not overfeed them. They should form habits of sterilizing vessels in which young animals are fed. Teach them how to make ewes own their lambs, and how to make them act as foster-mothers when they have lost their own lambs. Teach them how to treat simple animal

FIG. 45.—Wyoming high-school students of animal husbandry examining a horse for unsoundness. (E. E. Knudson.)

diseases. Teach them how to drive and work animals with care to get best results. Teach them how to manage young litters of pigs to prevent their being crushed. Teach them how to drive horses on hard roads without injury to their feet. These suggestions are given with the hope that many others will be brought to the minds of instructors as they are teaching students to do things.

Animal Husbandry Practices to Establish Proficiency.—In learning to do things in animal husbandry there are a number of operations which require proficiency. To secure this much practice is sometimes required. Try to train students to become exact and rapid in many ways. The following are a few of these operations upon which students should practice:

1. The detection of curb, bone spavin, bog spavin, wind puff, and thoroughpin (Fig. 45).
2. The detection of ring-bones, side-bones, scratches, and unsound hoofs.
3. The judging of gaits in horses to detect imperfections.
4. The detection of bad hearing and poor eyesight in animals.

5. The judging of age of horses.
6. The use of score cards of different types of animals of all kinds until students are able to judge without score cards.
7. Comparing animals in heart-girth, backs and loins, heights and widths, spring of ribs, length and angle of pasterns, and many other important points.
8. Comparing light horses in conformation, heavy horses in conformation, beef cattle in conformation.
9. Selecting good feeders among beef types of cattle.
10. Selecting good breeding stock among swine and other classes.
11. Shearing sheep until the work is made perfect or nearly so.
12. Treating swine for cholera until no mistakes will be made.

Things to Solve in Animal Husbandry.—Among the troublesome problems which present themselves to a student, and even to experienced men in animal husbandry, the following are but a few which come to the mind of a good instructor as the work of the course progresses:

1. When horses go lame, solve the difficulty by finding the cause and removing it, and applying proper remedies.
2. When you wish to produce hot-house lambs for market, how can the ewes be induced to breed out of season?
3. When sows eat their pigs, determine the cause, a good remedy, and stop the difficulty.
4. When animals are unthrifty as shown by their general condition and by their coats, find a suitable remedy.
5. When cows lose their young prematurely, determine the cause by thorough investigation, and watch for the contagious form of this difficulty.
6. When sheep lose their wool in large locks, solve the difficulty if possible.
7. When colts or horses scratch their manes and tails, find the trouble and stop it.
8. When pigs scratch on posts frequently, solve the trouble and apply the remedy.
9. When sheep have sore feet in winter quarters, find the cause if possible.
10. Determine how many pigs can thrive in the beef-feeding lot following a given number of steers.
11. Calculate costs and determine whether it would pay to purchase a machine for shearing sheep on your farm.
12. Solve the problems with balky horses, wind-sucking horses, and cribbers.

Reference Books in Animal Husbandry.[8]—Be sure that the reference library contains several books on each of the following: Swine management, sheep husbandry, beef cattle, horse husbandry, common diseases of farm animals. Special reference books on various phases, as the breaking of colts, the marketing of animal products, animal breeding, judging, volumes of the pure-bred livestock associations, and many others should be upon the shelves for ready reference. Get the latest lists from which to select reference books before ordering the books. Such lists may be ob-

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[8] See Chapter XVII and Appendix.

tained by writing to the States Relations Service, United States Department of Agriculture.

Animal Husbandry Bulletins.—Secure all the available farmers' bulletins which relate to any phase of animal husbandry and the subject of feeds. Get the many valuable publications of the Bureau of Animal Industry at Washington. Obtain all the animal husbandry bulletins you can secure from the state experiment stations. Write to all of them, or at least to those in your part of the country. Some of the stations issue very valuable bulletins on animal husbandry topics. Get publications of the various livestock associations. Some of these issue popular bulletins of an instructive nature. Besides these bulletins, rules for registering animals are issued.

Animal Husbandry Journals and Catalogues.[9]—There are many valuable periodicals issued by the different associations and private publishers. It is difficult to decide just which one of these to obtain for the school reading tables. If certain breeds of cattle, swine, etc., are of more local interest than others, the periodicals relating to these breeds should be considered most important. Some journals of a more general nature should also find a place on the reading table.

Frequently send for the new catalogues of breeders of pure-bred animals, and try to get the name of the school placed on mailing lists of noted breeders, so you will receive sale catalogues when they are issued. These will give valuable pedigrees from which students can study blood lines. Pictures of noted animals are also obtained in this way. Try to keep before the students the best things in animal husbandry so that they will form high ideals and strive for the best in their future careers.

EXERCISES

1. Make a list of the equipment you would want for the school in which you were going to teach animal husbandry. So far as possible, get prices for each of the items in this equipment.
2. Make a list of laboratory exercises which would aid students studying feeds and feeding.
3. Make a list of laboratory exercises for students studying swine husbandry.
4. Draw plans for the construction of a suitable farrowing house, for your climate.
5. Draw plans for a good sheep shed and make a list of material for erecting it.
6. Plan and build a good hay rack for sheep and another for cattle. Why should they be different?
7. Plan and build a hog feeding hopper and figure its cost.

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[9] See Chapter XVII and Appendix.

8. Conduct a community survey in one line of animal husbandry, such as you would have your class conduct.

9. Make one or several animal husbandry charts, which will teach special lessons and may be used in class-room or in farmers' meetings.

10. Make a list of ways in which the chemistry department, biology department, or physics department may correlate their work with animal husbandry.

11. Make a good short-course program for a three-days' course in animal husbandry suited to the farmers of your state.

12. Outline two or three type lessons on animal husbandry each as full as the "hog pasture" lesson is outlined in this chapter.

13. Make a list of ten topics suitable for debate in animal husbandry lines.

14. Make a collection of hoofs, jaws, skulls, teeth, and other parts to aid in teaching animal husbandry.

15. Make a list of the best reference books to be had in each of these fields of study: horses, beef cattle, dairy cattle, sheep, and swine.

QUESTIONS

1. State concisely the specific aim in animal husbandry.
2. Suggest important special methods in teaching animal husbandry.
3. Why would you want a full animal husbandry equipment on your farm if you were teaching in a normal school or college?
4. Why would you not want a full animal husbandry equipment on your grounds if you were teaching high school agriculture?
5. How does the equipment of the farms of the region influence the amount of equipment you would have at your school?
6. How would you conduct a laboratory exercise in studying the composition of mixed feed?
7. Mention ten points you would have students observe in examining a horse for unsoundness.
8. Give the advantages of post-mortem examinations in teaching animal husbandry.
9. Give a list of things to make while students are pursuing projects in animal husbandry.
10. Why would you teach docking, washing, shearing, castrating, dipping, and preparing fleece for market?
11. How would you teach each of these?
12. How would you teach the importance of pure-bred sires in a community?
13. How would you use livestock of your region in teaching lessons to the class?
14. Give reasons for an animal husbandry survey.
15. Mention the most important questions for a typical survey.
16. How would you obtain answers to these questions?
17. How would you "digest" the results of a unit survey?
18. Give a list of unit surveys in animal husbandry.
19. Give a list of good subjects for local lantern slides in animal husbandry.
20. What may be the value of special assignments in animal husbandry magazines?
21. Mention a number of discoveries to be made in animal husbandry.
22. Give good subjects for animal husbandry discussions.
23. Give good subjects for animal husbandry observations.
24. Give good subjects for animal husbandry drills.
25. Give a list of things to solve in animal husbandry.

References.—Bulletins on teaching animal husbandry: H. R. Smith, Univ. of Neb.; U. S. Office Exp. Sta., Cir. 100; Purdue University Bul.

CHAPTER VII

HOW TO TEACH DAIRYING

The specific aim of the work in dairying is to enable young people to obtain such a knowledge of the characteristics, care, management, breeding, improvement and sale of the dairy breeds of cattle and the handling, manufacture, use and marketing of their products as will prepare them for success in special dairy farming.

The aims in this chapter are (1) to give suggestions on how to teach the dairy husbandry side of this subject and (2) to suggest how to teach the handling, manufacturing, and marketing side of the business. The first of these two aims has been partly met in the preceding chapter on the teaching of animal husbandry. A number of suggestions dealing particularly with dairying are given in the present chapter to supplement those suggested in the preceding chapter.

Animal Husbandry Equipment for Teaching Dairying.—In many high schools offering vocational dairying and having farms of their own, a small dairy herd is kept at the school. When such equipment is provided the barn for the housing of stock should be of a model character so that conditions may be somewhat ideal for the production of clean milk. Good stalls, preferably of iron, concrete floors, and gutters, good facilities for handling and storing feed should be provided.

The number of cows in the school dairy herd need not be very large so far as the teaching value is concerned. If the school is provided with a herd of dairy cattle certain other equipment is also necessary, such as a silo, pasture, and exercise lot. Some additional machinery may be required, such as a manure spreader, wagon for hauling feed and hay, ensilage cutter, market wagon, and perhaps tillage implements. The latter will be needed in case field crops are raised for the cattle.

Other Dairy Equipment.—All schools teaching dairying, either as a special subject or as a part of the general course in animal husbandry, should be well provided with testing equipment. This would include one or more centrifugal machines, milk testing bottles, cream testing bottles, skim-milk and buttermilk bottles, pipettes, acid measurers, a supply of commercial sulfuric acid, milk

sample bottles, milk weighing scales for weighing milk from the herd, cream scales for weighing test samples, preserving tablets, milk weighing record sheets, a Nefus tester for testing the accuracy of glassware, dividers for reading fat columns, etc.

In special dairy courses, instruction should be given in the bottling of milk and cream, the manufacture of butter, and the making of one or more kinds of cheese. Apparatus for bottling should include a small multiple bottler, a good aërator and cooler, and utensils suitable for handling milk and cream received in the laboratory. One or more types of hand separators should be available for use in the laboratory.

For butter making have one or more churns of suitable size to accommodate the size of the class and to handle the amount of product desired. In regions where home butter making is the chief form to be taught, churns of suitable size for home use should be used even if several are required at the school. Small revolving churns of the barrel type, either made of wood or crockery, are good for home use. Butter molders, bottles, apparatus for testing acidity of cream, butter color, salt, parchment paper, sanitary cartons, etc., should be provided. Several of these are supplies which will need to be renewed as used. If large quantities are to be made and handled in wholesale quantities, perhaps methods of packing in butter boxes and tubs should be taught. Provide butter boxes, tubs, and packers for this purpose. Cutters showing how boxes and tubs of butter may be cut into pound molds should be found in the school equipment. Scales for weighing butter, salt, etc., are necessary.

Vats for handling large amounts of milk and cream may be necessary. Cheese vats or large vessels should be ready for use in teaching methods of making cheese. If cheddar cheese is to be made, presses should be either improvised or purchased.

The dairy laboratory should be provided with suitable sinks and with hot and cold water for the washing of dairy utensils. For this work provide brushes of several types. It is desirable that the dairy floor be made of concrete and that this floor slope to a floor drain at one side or in the center.

If a number of dairy cows are kept, or if the school maintains a neighborhood milk depot or large bottling plant or butter factory for farmers of the region, much additional apparatus will be needed. In such cases a special dairy expert will be employed and perhaps one or more assistants will be needed. Facilities for marketing the

products will be included in the additional equipment. Large weighing cans and scales for measuring milk or cream supplied by farmers of the neighborhood will be necessary.

Class Work in Dairying.—It may be assumed that in many schools the class work may be based upon home projects conducted by students of the class. If the home project plan of instruction is not possible because students live in boarding houses or dormitories, it may be possible for members of the class to perform group work in projects at the school or college.

In any case, the class instruction should be based upon practice work of the students. This practice work should, if possible, be conducted at the same time of year as the class instruction is given. In some cases, however, the practice work may precede the class instruction.

The lessons in dairying should consist of topics directly connected with steps in project operations. Examples of the steps in such projects are: Judging dairy cattle; selecting a dairy herd; selecting a sire; culling a dairy herd; raising dairy calves; developing dairy heifers; constructing sanitary barns; controlling diseases in herds; problems in feeding; registration and advance registry; sale of pure-bred stock; manufacturing of dairy products and marketing dairy products.

A Type Lesson in Dairying.—Suppose that the lesson assignment at a preceding meeting of the class has been upon the subject of culling a dairy herd. Suppose also that the class understands the methods of testing milk. In the assignment of the lesson students should be given topics individually or in small groups such as: (1) Calculate the butter-fat income from the five poorest cows in each of five herds in a certain cow-test association's reports. (2) Calculate the income from the five best cows in these same herds. (3) Calculate the average income of the best cow in each of all the herds in that association. (4) Calculate the average income of the lowest cows in all the herds of that association. (5) Compare the average income per cow from the highest and lowest producers in five of the herds. (6) Compare the incomes of the ten poorest cows in the association with the ten best cows in the association. (7) Describe how cow-testing associations are conducted and financed. (8) Figure the cost and profits for the owner of the largest number of cows in this association.

For studying this lesson the class should have enough copies of the report of a large cow-test association which has been running

for one or more years. Such reports may be obtained by writing to dairy divisions of state experiment stations. Students in studying the lesson may be shown how they can make graphic representations of the figures which they have gleaned from special assignments made.

At the time of the class recitation, let each group be called upon to report. Perhaps the first topic should be number seven above. The students who have made graphic representations of their topic studies should put them on the blackboard. Have available at class time good and poor dairy cows to show to the members of the class to illustrate the different types of producers which they have been studying. If the cow-test association is a local one, the very cows that are the poorest and the best in the association may be brought together for comparison. If cows are not available for use at the time of this class recitation, photographs or other pictures of them may be exhibited. Careful questioning on the part of the instructor will induce all members of the class to fix strongly in their minds the value of cow-test association work as means of culling of the dairy herds. The methods of weighing and testing milk regularly and calculating the income from these results should be drilled upon until the instructor is sure that every member of the class understands the required conditions for culling dairy herds. Several examples of figuring incomes from individual cows may be worked out on the blackboard by members of the class. One or more charts which will show clearly to the class the value of testing and weighing may be used in this recitation. At the close of the recitation, suggestions from members of the class may be volunteered for the disposal of poor dairy cows. Are they suitable for beef? Is the owner losing money by disposing of these cows at prices lower than prices of good dairy cows? (See the type lessons in Chapters VIII to XII.)

Dairy Laboratory Work.—If the school is equipped with a production laboratory in dairying, *i.e.*, a dairy herd and barn with necessary surroundings, the members of the class should have regular practice work with this equipment. There are two good ways of managing the labor problem connected with such a dairy barn.

1. The members of the class may be given definite assignments for certain specified days and hours for duty in the dairy barn. There they will do at certain hours the milking in their turn, the cleaning of cows in their turn, the feeding of animals and handling of manure. Other assignments of barn work may be the hauling of

concentrates, fodder, and hay; the care of calves and dry stock; the cleaning of the barn lot; the taking of cows to and from pasture. The assignment for each student should be carefully scheduled by the instructor, so that no student will have the same kind of work for too long a time. All students should be allowed to have practice in all the kinds of work with the herd. An instructor or foreman should be on hand when students are performing this laboratory work so that proper instruction can be given them.

FIG. 46.—Dairy students making ice cream. (R. S. Mackintosh.)

Perhaps advanced students in the school in the capacity of monitors or instructors should be at the barn.

2. The project plan of conducting the work with the dairy herd is used in some schools. First, the herd is divided into small groups with certain cows or animals in the group. These groups are lettered and a printed or typewritten list is posted where all students may know how the animals are grouped. Each student will do all the work necessary for the complete care of the animals in his group. Suppose he has a group of three milch cows. He will water, feed, clean, remove the manure, and milk this group. Another student may have a group of calves or dry cattle and completely care for

them. The length of time which each student does the project work with his group should be planned so that the members of the class will have two kinds of projects with the herd during the course. When a student takes up the project of a former dairy student the instructor should remind him that his results will be compared with the former operator of that project. Some competitive spirit among the members of the class may thus be aroused. Next the work of caring for and managing each group is assigned to a particular student for a specified length of time. The size of the groups will

Fig. 47.—Dairy students performing individual exercises. (E. A. Wright.)

be governed by the number of animals and the number of students in the class.

Indoor Laboratory Work in Dairying.—Suppose the laboratory is equipped for several types of work, such as: (1) Separating, (2) bottling, (3) ripening of cream, (4) making of butter, (5) making of cheese. Let each student or small group of students be assigned at different times to the above kinds of laboratory work (Figs. 46 and 47). Do not keep the same students on the same kind of laboratory work constantly. A rotation system in this or any type of work should be established by the instructor. Make a clear schedule of the types of work and the students assigned to each kind of work. If there are five kinds of work, make five groups of students and let them rotate each week or so. For the testing

of milk and its products, students may work in unison at the same exercise (Figs. 48 and 49).

In the laboratory work care should be exercised by the instruc-

FIG. 48.—Practicing the testing of milk in the Flathead county high school, Montana. (Carl A. Carlson.)

tor to see that each student is diligent in the performance of practice work assigned him. His methods should be closely scrutinized and suggestions given frequently for their improvement. Never

FIG. 49.—Testing milk from the home herds in the Alexandria, Minnesota, high school. (W. P. Dyer.)

let the student assume that he is beyond the point of learning better methods. Neatness and cleanliness are most important in dairy work. Each student must be expected to wash up the apparatus and equipment which he has used. Each student should feel that he is to wash and clean up more than his share if possible.

The best methods of cleaning should be drilled into the minds of all so that none of the equipment will become filthy.

Using the Community for Dairy Teaching.—In the animal husbandry side of dairying the dairy herds of the community can be used to good advantage. Classes may be taken to dairy barns, where the special structure and equipment may be studied.

The score cards issued by the United States Dairy Division may be used in scoring dairy barns, dairy equipment, and dairy methods.

FIG. 50.—Dairy cattle scoring and judging. Give students enough practice with young and old animals of both sexes to make them exact and rapid in the work. (Chas. J. Booth, Calif., and E. H. Thompson, Okla.)

Methods in dairy feeding, making and preserving of ensilage, structure of silos, the handling of manure, the culling of herds, the methods of breeding, the methods of raising calves, and many other special problems may be studied on farms of the community.

In localities where there are milk depots, milk bottling laboratories, butter factories or cheese factories, these should be visited. The equipment and methods should be studied.

Judging of dairy cattle may be conducted either by taking the students to farms where the cattle are found or by having the animals brought to the school grounds (Fig. 50).

The study of diseases of dairy cattle may be made the center of

interest for a number of dairy trips. The instructor can usually obtain permission from the state veterinarian to take his students out to dairy herds for testing the animals for tuberculosis (Fig. 51). In states where such permission is not granted local veterinarians who do such testing in the region are usually glad to let the dairy class participate in tests of farm herds. The students should understand the methods and regulations governing such tests. Methods of inoculating to prevent "blackleg" may be taught in one of these ways (Fig. 52).

A Dairy Survey.[1]—Early in the term the students and instructor should conduct a community survey relative to dairy husbandry and

FIG. 51.—Giving at the school the first lesson in testing cattle for tuberculosis.

dairy practices. This survey may be made the basis for much of the community study and the class instruction. The following questions are suggested as ones which may be included in the survey card:

Name.	Location from school.
Size of farm.	Acres devoted to dairy pasture.
Size of main dairy barn.	Number of box stalls.
Number of individual stanchions.	Other dairy buildings.
Number of cows milked.	Number of dry stock, including calves.
Breed, pure or grade.	Kind and size of silo, if any.
Kind of products sold.	Amount per month.
Disposal of male calves.	Is milk weighed regularly?
Is milk tested regularly?	Minimum standards for culling herd.
Facilities for storing dairy products.	Kind of separator, if any.
Facilities for manufacturing products.	Is herd systematically tested?
Is the herd considered profitable?	

Special Aids in Teaching Dairying.—Charts [2] showing contrasts

[1] See other survey suggestions in Chapters V, VI, and VIII to XII.
[2] See Chapter XVI.

in each of the leading points of the dairy score cards are of great assistance in teaching students how to interpret the score card. Rear views, side views, front views, and top views of both good and poor types of animals should be shown on such charts. Contrasts of this kind may be either explained on the chart or by the instructor. The school may make charts which may be illustrated by cows from dairy journals and by photographs. A chart may show the steps in butter making. Another may give the steps in cheese making. Another may give the steps in ripening cream

FIG. 52.—Many agriculture instructors teach their students how to inoculate to prevent "blackleg." (R. V. Morrison.)

with the starter process. Another may enumerate the difficulties and corresponding remedies in operating hand separators. Another may give an outline for studying hand separators. In elementary schools, charts showing the pictures of the dairy breeds should be available.

The dairy instructor and members of his class should collect pictures of dairying as it is practiced in the community. These may be used for comparative instruction, either as photographs or as lantern slides. Other lantern slides may be purchased. Most of the dairy slides on the market are of an elementary nature and are useful in classes beginning the subject.

The laboratory should be supplied with samples of dairy feeds of many kinds. These may be used in teaching the nature, appearance and weights of certain feeds. Many of these contain weed seeds

which may be examined by the use of a microscope or by special tests in germination.

Teaching Dairying in Rural Schools.—Among the important lessons in dairying for use in elementary rural schools are: Testing of milk and cream for butter fat; judging of dairy type of cattle on farms near the school; study of dairy barns and other equipment; the use of silos; the changes in milk due to bacteria and temperature; the principles of storing milk; the importance of cleanliness in milk production.

Much of the work in rural school dairying may be based upon the home practices of the students. They should be asked to bring

FIG. 53.—Students should show pure-bred animals from their project herds at fairs. Young Guernseys. (W. P. Dyer.)

their dairy problems to the school for solution. Let them bring the weights of milk from each of the cows for one week. Let samples of the milk be taken for testing at the school. Arithmetic problems may be formed for calculating the butter fat, the total production, and the probable income of the members of each herd. Farmers' bulletins may be used in reading lessons.

These may concern the different breeds of cattle, the various dairy practices, and other topics. Spelling, drawing, and composition work may be based upon dairy practices and dairy lessons.

Dairying in Town Grades.—In those sections of the country where dairying is of great importance the families living in villages and small cities will be much benefited and interested by lessons in school. The school work for a week or more at a time may be

largely centered about dairy topics. Children may be taken on trips where dairy products are handled and the trips may be written up by students afterwards. The manufacturing side of the business will be of more value and interest to such children than the production side. Experiments may be conducted in school to show the composition of milk, and perhaps the testing of milk and cream for butter fat. Charts and pictures should be used to make all the lessons as clear and real as conditions will permit.

Short Courses in Dairying.—The needs of the community should be well considered when planning a dairy short course. If a high school, for example, is planning to give a course for a week or so specially devoted to dairying, the shortcomings of the people in the community should be taken into consideration and these should be eliminated as much as possible. Stress those features which the community needs. Of course the financial betterment of the dairy interests should be uppermost in the minds of those planning the course. For example, if the butter making of the region is so poor that the product is sold at a very low price, good butter making should be taught at the school. If farmers are milking very poor cows and do not understand methods of improving their herds, these problems should find a place in the short course. If a neighborhood butter factory will greatly benefit the community, and perhaps is being suggested by a few dairymen, the problems of coöperation in dairying may be considered with profit.

Base the short-course work on actual experience of men in the dairy work. Have actual dairy operations in progress for their lessons. Have animals there with which to illustrate many of the points discussed. Lantern views may be used at night by way of entertainment and instruction. Have charts on the walls constantly before the short-course students so that they will unconsciously gain many lessons which they might otherwise miss. By careful planning, the illustrations and charts can be used to emphasize and reiterate the teaching given in laboratory experiments and demonstrations. A few field trips to worth-while places may be planned with definite aims in view. For example, if the selection of herd sires or of dairy cattle is to be taught, the students may go with the leader where a number of animals may be used for comparing important features in the problem of selection.

Most of the principles here stated will apply as well to college short courses as to others in dairying. The main difference is in the wider range of territory from which the students come. College

short courses are usually longer than others and may include many more dairy topics.

Discoveries in Dairying.—Students in dairy courses should always attempt to discover better methods of producing clean milk; better ways of keeping the cows clean; better ways of keeping out flies; better ways of preventing sickness among dairy calves; better ways of marketing dairy products; better methods of feeding. They should discover what cows are paying least and eliminate them from the herd. They should discover the best methods of maintaining pastures. They should discover the chief causes of loss and how to eliminate these causes.

Dairy Discussions.[3]—The skilful teacher can arouse students to discuss among each other and at their homes many topics in dairying. They may propound topics or questions as if some great change were about to take place in the community and arouse considerable valuable discussion among the students and farmers.

Sometimes it is a good plan to have certain students glean from the survey cards all the answers to some particular question, as the number of pure-bred cows or the number of grade cows. Let the students of the school then get from all the dairies of the region the quantity of milk being produced daily by each. These may be compared on the basis of breeds. Grades may be compared with pure breds in production. If the subject of individual production of cows arouses considerable interest, let the best cows of the neighborhood be compared with each other from time to time. Do not neglect to compare also the poorest cows in the same herds. There is no easier way to teach dairying than to keep such discussions constantly going. Students will teach each other, and teach their parents more than many farmers' institutes could teach them.

Dairy Observations.—Close observation of important points in dairying should be taught to young people. Instructors should call for important observations from students. This will show that their observations are important enough for notice, and that their observations are in harmony with those of experienced dairymen or are contrary to good authorities. A few such features of observation are here suggested: (1) The influence of dirty cattle and dirty barns on the keeping of milk. (2) The influence of breed and of individual type on quantity of milk and richness of milk. (3) The influence of breed on the weight of calves at birth. (4) The effect of silage on maintaining winter flow of milk. (5) The effect

[3] See topics for debate, Chapter XI.

of good housing on the winter flow of milk. (6) The effects of too strong or too weak acid in the testing of dairy products. (7) The effect of temperature in the separation of cream. (8) The effect of feeds on the color of butter and cream.

Things to Do in Dairying.—Students should form good habits of doing things right in their dairy operations. Careful habits mean much in the production of high-class dairy products. Good profits are sure to come to those who form the best dairy habits when they are learning the business. Learn to clean the cows always before milking. Learn to have clean hands during the milking operation. Learn to wash the hands before milking the next cow. Learn to milk in pails with small mouths to prevent dirt from falling into the milk. Learn to handle milk stools without getting your hands dirty. Learn to handle the best kinds of milk strainers and habitually change them frequently. Learn to have the air and floor of the barn always clean at milking time. Learn all the ways of keeping down flies so that none will ever reach the milk. Learn to cool milk by simple methods to reduce the multiplication of bacteria. Learn to put up ice and store it for winter use if possible. Learn to make the very best butter and cheese. Learn to wash dairy utensils so they will not become gummy. Learn to use clean garments in handling dairy products. Learn to pack or otherwise prepare the most attractive dairy products for market. Learn to test your cows for tuberculosis. Learn to detect animals with garget, bloody milk, and other affections.

Things to Solve in Dairying.—Problems for solution often present themselves to the student and to the dairyman. A few of these problems are here suggested:

1. When dairy cows fail to chew their cud, determine if possible what has been the cause. See if the rumen is packed and determine the best means of relieving the difficulty.

2. When you know that your dairy herd is not paying enough profit, find what course to pursue in order to increase the profits, *i.e.*, to practice better feeding or to get a better sire or to dispose of the poorest producing cows.

3. If the heifers of your herd produce less than their mothers, how can you reverse the game and raise heifers that produce more than their mothers?

4. When you are losing calves by premature birth, solve the cause if possible and prevent the terrible loss.

5. When your neighbors are getting more for their dairy products than you are, find the real reasons for the difference and apply the remedies to your business.

6. When milk depots are cutting prices or holding them below cost of production, solve if possible the best way of inducing them to pay living prices to yourself and other dairymen.

7. When dairymen fail to coöperate with each other, solve the causes of failure and try to establish methods of successful coöperation.

8. When coöperative creameries or cheese factories or milk depots fail to yield satisfactory profits to the members, try to find the causes of failure, as careless operators, dishonesty among managers, treachery started by competitors, and poor business methods.

9. When separators fail to give satisfactory results, examine conditions closely and solve the trouble if possible.

10. When prices of feed soar upward, try to solve the problems of economic feeding of cattle by production of clovers, alfalfa, and other feeds rich in protein.

Dairy Readings.—The literature of the dairy world is rich in valuable matter. Students should be induced to read reports of dairy shows, dairy conventions, papers on special dairy topics, new dairy bulletins, dairy columns in agricultural journals, discussions in special dairy magazines. Have students take certain articles home to be read to the family. Have them read special assignments for report to the dairy class for debate in special exercises, for discussions at farmers' meetings, and for use in their project operations.

Dairy Reference Library.[5]—The shelves of the school library should be provided with many of the valuable books on dairy cattle, methods of feeding dairy stock, and on the different phases of manufacture and sale of dairy products. Some of these relate to the organization and management of dairy associations. Obtain a complete up-to-date list of such books by writing to the States Relations Service of the United States Department of Agriculture. Select the best books from this list unless the school can afford to purchase all of them.

Dairy Bulletins.—The phases of dairying are briefly covered by special dairy bulletins issued by the United States Dairy Division and Farmers' Bulletin series. Many of the state experiment stations issue good bulletins on this subject which should be obtained so far as they are available. Arrange these bulletins for handy use as suggested in another chapter.[6] Much of the reference work on dairy projects may be to these bulletins.

Dairy Journals.[7]—Obtain a complete list of the best agricultural papers of the country that have good dairy departments, including the special dairy markets. Obtain sample copies of all of these and then subscribe for the ones which will best meet the needs of the school.

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[5] See Chapter XVII and Appendix.

[6] See Chapter XVII.

[7] See Chapter XVII and Appendix.

EXERCISES

1. Outline two or three typical lessons in dairying, on other phases than the sample given in this chapter.

2. Make a long list of laboratory exercises in dairying, which would make the course more real and practical.

3. From your observation, or experience, make a list of dairy exercises which could be conducted in the community, for the benefit of your class.

4. Conduct a brief dairy survey, of a small region, for practice.

5. Make a list of dairy pictures which you would collect and mount for use in this course.

6. Collect one set of these pictures and mount them.

7. Make a chart to teach the importance of clean milk production.

8. Make a score card for examining and judging a cream separator.

9. Another for a churn.

10. Make a program for a short course in dairying, working in as many practical exercises and demonstrations as would be suitable.

11. Make a list of ten, or more, topics for debate on dairy subjects.

12. Make a list of the processes and methods used, and give the steps in these, for preparing dairy animals for shows (Fig. 53).

QUESTIONS

1. State the specific aim of the dairy course.
2. Give a rather full list of the dairy equipment.
3. Give your ideas of the kind of work to be done by the dairy class.
4. Review and criticize a typical lesson in dairying.
5. Describe how students may obtain dairy herd practice: (1) when the school is equipped with a herd; (2) when the school has no herd.
6. Mention the chief lines of indoor laboratory work in dairying.
7. Describe an exercise in dairy judging with score cards.
8. Describe exercises to teach students dairy feeding.
9. Describe a trip to visit and study a milk depot, or factory.
10. Describe a trip to test a dairy herd for tuberculosis.
11. Give the points to be included in a dairy survey.
12. What use would you make of such a survey?
13. Give a list of local dairy subjects suitable for lantern slides.
14. How would you use a collection of dairy feeds in your class?
15. Give suggestions for teaching dairying in rural schools; in town grades.
16. What courses in agriculture are of most importance to the teacher of dairying?
17. Make a list of discoveries to be made in dairying.
18. How would you start dairy discussions among your students and their families?
19. Make a list of dairy observations to be made.
20. Give a list of problems to be solved in dairying.

CHAPTER VIII

HOW TO TEACH POULTRY HUSBANDRY

"The specific aim of the work in poultry is to enable young people to obtain such a knowledge of the characteristics, breeding, feeding, care, and management and marketing of farm poultry as will prepare them for successful poultry raising."—Report of Committee on Agriculture of the N. E. A. Commission on Reorganization of Secondary Education.

The aim of the present chapter is to consider such special methods as will aid instructors successfully to lead their students to a clear understanding of the subject of poultry husbandry. Special methods are here suggested. These have been thoroughly tried by one or more schools where the subject is taught. Instructors of poultry husbandry who are seeking the best methods of teaching the subject will be able to follow many of the suggestions given, and to devise and adapt them to suit the local conditions of any school.

Special Methods in Poultry Husbandry.—This subject is so popular and the cost of materials is so slight that no school should attempt to teach it without basing the instruction upon practice work. A number of the special methods to be more fully considered in this chapter will include such exercises as class demonstrations in culling fowls, judging fowls by standards of perfection, selection of breeding stock, mating pens, and examining for diseases and enemies. There must be exercises in the operation of incubators, brooders, management in natural incubation, natural breeding, exercises in caponizing, treatment of diseases, feeding, killing, dressing, and packing. Include exercises in sorting and packing eggs, preservation of eggs, and their shipment for hatching purposes. There should be work in the making of sprouting trays, feed hoppers, water fountains, trap nests, broody coops, brooders, and movable poultry houses. Do not fail to include such exercises as cleaning and disinfecting of dropping boards, whitewashing and spraying the interiors of houses, and cleaning and disinfecting brooders and incubators.

Content of Poultry Husbandry.—In most vocational high schools and other high schools, the poultry course should usually be made up largely of the study and management of chickens. However, in some instances the course may be made to include a study of other kinds of poultry, such as ducks and geese, the raising

of turkeys (Fig. 54), the care and management of pigeons. Perhaps other departments of poultry husbandry may occasionally be included, particularly if there are examples of the work in the community. In a survey recently made of five hundred farms in northeastern Missouri it was found that most of the farms included only chickens and did not include other kinds of poultry. A very small percentage raised turkeys and even smaller percentages raised ducks and geese.

Just what to include in the course should be determined by local surveys made through the students. These surveys should

FIG. 54.—The growing of turkeys may be a profitable home project for either boys or girls. (H. A. Savage.)

also reveal to the instructor the most important topics of the subject to be stressed in a particular neighborhood. The instructor should then exercise good judgment in regard to the amount of time to be devoted to each part of the subject matter in the course. The order in which the subject should be studied should usually agree with the season of the year. For example, if the course is given in the last half of the school year, some study should be made first of winter housing and the whole question of types of houses can be considered early in the course. This should be followed with lessons in incubation and brooding as the season progresses. Suit the topic to the time of year as nearly as possible.

If the course is to be offered in the fall, the possibility of making the topics seasonal is much more difficult. If the course opens in September, the study might well begin with small parasites, such as

lice, mites, and others. Disinfecting of quarters should be considered early in the course. Culling of the young stock, preparation of winter quarters, breaking the fowls to habits of roosting in their winter quarters, and the installation of winter methods of feeding will all come along rapidly as the season advances.

It is readily understood by the instructor that the author of a textbook on poultry husbandry would not be able to arrange the subjects in the course or a chapter in the book to suit the season. It is therefore necessary that the instructor use emphatic decision in regard to the choice of subject matter and the arrangement of the course so that the work of the students will be timely and so that it can be well illustrated by practice in poultry yards. If the poultry textbook should be followed in order from cover to cover,

Fig. 55.—Boys of the agriculture class inspecting the home project of one of their number. Remodeling a hen house near Lamar, Ark. (M. R. Ensign.)

Fig. 56.—New York students of poultry built this brooder house for their school.

much of the teaching would necessarily be abstract, out of season, and merely theoretical. Students would not retain the lessons and the teaching would not be vocational.

Equipment for Teaching Poultry Husbandry.—Every school should, if possible, own at least a small equipment for the teaching of poultry husbandry. An equipment of fowls and houses is a valuable asset in the teaching of this subject. In some cases it may be found advisable to use a neighboring flock for practice and illustration instead of having a flock owned by the school. In vocational schools where the instructor is employed for the entire year the school should, if possible, provide itself with a flock of fowls and equipment for the housing and management of the same.

The number of fowls kept by the school may be a hundred or less, and the number of houses should be such as to group these fowls into small lots of twenty or so. Each lot may be assigned to a

group of students for daily care and management. The houses for this purpose should in most instances be movable, and may be used to illustrate the movable, or colony type of house (Figs. 55-57). The interior equipment of each house should be as complete as possible, including sanitary nests, roosts over a dropping board, a dry mash hopper, a water fountain on an elevated platform, perhaps a broody coop in one corner, receptacles for grit, charcoal, and dust. There should be yards for fencing different lots of poultry separate from each other, and enough area to allow for some rotation and movement of houses.

In some convenient place there should be a room suited to the

FIG. 57.—Poultry students may build the school brooder houses. (H. N. Loomis.)

running of incubators (Fig. 58), and several machines should be provided so that students may operate these either singly or in groups. Either a large brooder house of the shed type with several compartments may be provided or there should be a number of small brooder houses.

In selecting the poultry equipment, the plan of the instructor should be to provide for practice of students, either in small groups or separately, in all phases of poultry keeping. If suitable poultry practice is thus provided at the school, the student is able to learn the minute details of poultry husbandry much better than if his practice consists of home project work only.

Class Work in Poultry Husbandry.—In the field of poultry husbandry large opportunity is given for instruction by the topical method. Let students be assigned special topics to report to the

class. The assignments should be definite and reference to texts, library books, and bulletins should be made.

Let the daily recitations correspond as closely as possible with the practice work which is being pursued. The class work should

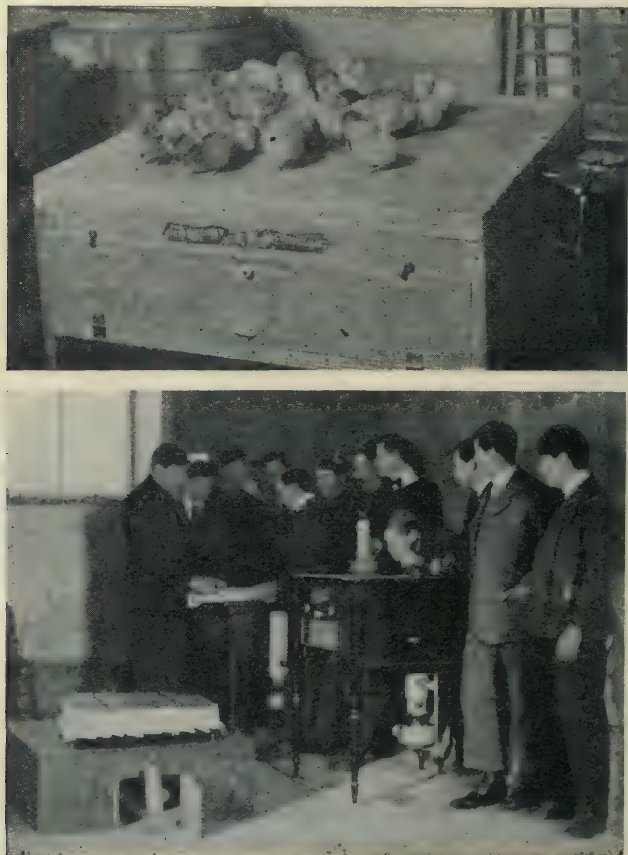

FIG. 58.—Students learning to operate incubators in the school basement. The lower brooder was made by a student.

usually precede the laboratory work. For example, it is better to study regarding the operation of incubators before actually beginning their operation. Study the mixing of dry mash before actually mixing it. Study how to fight lice before actually fighting them. In all cases, link the two parts of the work as closely to-

gether as possible. There are many bulletins issued by the United States Department of Agriculture and by state experiment stations which will be helpful in conducting the class work. A single bulletin may sometimes be divided among several students.

There will be no lack of interest in the class work in poultry husbandry, provided the instructor is careful to question students regarding their difficulties in the practice work. Methods of operation should constitute a large part of the class discussion. A subject so full of detail as poultry husbandry will make the class work full of discussion of methods, management, and operation. Trying conditions are always presenting themselves and students should be encouraged to bring their experiences, difficulties, and problems to the class for solution. (Fig. 58.)

Review Work.—Pick up the details of the class work and laboratory work by having frequent reviews. For the purpose of testing the thoroughness of the preparation of the students use questions at the close of different chapters in some good textbooks. Many points which might otherwise escape the attention of students will thus be brought out, and doubtless many errors will be prevented.

The topical method which has been suggested for conducting a recitation in poultry husbandry requires more attention to review work than in any other method of recitation. If all students are required to pursue the review questions and bring up the "odds and ends," the class work will be made more thorough and students will feel that they are masters of the subject matter.

Laboratory Work in Poultry Husbandry.—Suggestions have already been made regarding certain laboratory work which should be done. By the term laboratory, we mean in this case, at least, outdoor as well as indoor work. Several of the lines of laboratory work may be either out of doors or in the laboratory. Selection of the foundation stock may be conducted either in the poultry house or by the use of coops in the school building. This is also true of all such exercises as the following: The selection of breeding cockerels, selection of hens for hatching, judging of standard-bred poultry by the score card, the operation of caponizing, preparing dressed poultry for market, dressing and trussing exercises, grading and packing market poultry, candling and grading market eggs, diagnosing poultry diseases, and the study of market types of live poultry.

There are a number of poultry laboratory exercises which are

best suited for work in the laboratory or other inside room: The identification of feed stuffs, study of ready mixed rations, study of construction and operation of incubators, study of construction and operation of brooders, the home preservation of eggs by water glass, planning and use of poultry records and accounts, exercises in preparing poultry for exhibition, studying and compounding poultry medicines, anatomical study of the fowl, the development of the chick embryo, and the study of the reproduction system of the hen.

There are certain types of poultry laboratory work which should be conducted either out of doors or in some shed or other sheltered quarter. Among these may be mentioned the construction of brooder houses, the building of movable poultry houses, making such articles of equipment as hoppers, nests, trap nests, broody coops, water fountains, hen coops, exhibition crates, shipping crates, and others.

Such exercises in sanitation as spraying of poultry houses for lice and mites; whitewashing; cleaning of nests and dropping boards; the painting of roosts with oil; treatment of fowls for scaly leg, lice and other troubles will naturally be performed in the places most convenient for such work. Students should have practice in all of them if possible.[1]

Poultry Trips.—The poultry plants or farm poultry flocks in the vicinity of the school should be used by the class in poultry husbandry. When the care of young stock is up for consideration, visit the farms of good poultry keepers and study their methods in this regard. Trips to successful poultry farms should be made to study the plans of building, layout of yards, and methods of care and management. It is often possible to ascertain the expenses and revenues of good poultry keepers.

It is well to make trips with poultry students to wholesale and retail poultry and egg markets. There the student should become familiar with methods of distribution of poultry products. Learn as much as possible about the commission business, the retail business, methods of packing, conditions in which products are received, and how they are shown to customers.

If possible, visit cold storage plants where poultry products are stored. Learn the methods of storing various kinds of poultry products and temperatures at which they are kept. Also determine the rates, storage periods, shrinkage, insurance, and cold storage regulations.

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[1] See Lewis' "Poultry Laboratory Manual and Notebook."

If there are poultry-packing and egg-packing establishments within easy distance, the students should be allowed to study the methods carefully. This study should include such points as the feeding period preceding slaughter, methods of killing, rough picking, clean picking, methods of checking, and prices paid for this work. Study methods of plumping, cooling, grading, packing, and shipping.

Outline for Study on Poultry Trips.[2]—When students are planning a trip to inspect neighboring poultry plants for instruction purposes, a suitable outline for study should be made in advance. This should include all the phases of study which the trip is intended to cover. Be sure to include all of the special methods and practices which the instructor may know are carried on at the poultry plant to be visited. A suggestive outline is here presented. This, however, should be modified for each trip and should be adapted to the conditions in any particular locality. The outline may be taken down in a notebook by each student, or furnished by duplicating, and each should be expected to use it during the study of the plant visited.

Details of the Outline.—Include the following points and any others desired:

1. Name of plant.
2. Distance from shipping point or market.
3. Kinds of products produced for market.
4. Methods of selling.
5. Prices received for different products.
6. Breed of poultry kept.
7. Number of mature stock.
8. Number of young stock.
9. Methods of hatching.
10. Methods of brooding.
11. Methods of feeding. Dry mash, wet mash, scratch feeds.
12. Methods of housing. Number of houses, size, amount of glass ventilation, etc.
13. Is trap nesting practiced?
14. Methods of culling mature stock. Young stock.
15. Yarding systems.
16. Litter and scratch systems.
17. Kinds of fountains.
18. Notes on broiler production.
19. Preparation of broilers for market.
20. Notes on egg production.
21. Preparation of eggs for market.
22. Notes on roaster or capon production.
23. Preparation of these for market.
24. Amount of labor required.
25. Cost of labor.
26. Labor-saving devices.
27. Ease of watering.
28. Ease of cleaning.
29. Sanitary methods.
30. Amount of loss from sickness or death.
31. Are quarantine coops kept?
32. Other precautions against disease.
33. Calculation of probable labor cost per year.
34. Calculation of income per year.
35. Calculation of probable net profits.
36. What accounts are kept by the owner?
37. General criticisms.
38. Special criticisms.
39. Best points observed.

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[2] See also Chapter IV.

Use of Poultry Shows.—The poultry students and instructor should plan to attend all good shows of standard poultry. Perhaps they will be able to participate in a show by selecting an exhibition from their home stock or by selecting birds belonging to the school flock.

At the show they should become familiar with the breeds of poultry and methods of staging them. The work of judging and managing a show should also be studied by such students. They should learn to know exhibitors of the leading breeds. There is often good opportunity for studying such exhibits as poultry appliances, poultry feeds, packing, shipping, charts, and methods of advertising.

Relating the Laboratory Work to Project Methods.—In some schools there are students who do not go home daily, or frequently enough to conduct poultry projects at home. Such students can readily be assigned to projects at the school. If there are a number of such students, they may work in groups with small houses of laying hens, with incubators, and with flocks of young chicks in brooders. If they are assigned these tasks as projects which they pursue for profit, they will be more willing to do the chores regularly and frequently than if they work merely as performing a laboratory practice. Nearly all of the care of the school flock may be thus divided among students who are doing the work for profit as well as for instruction.

Value of Poultry Surveys.—Instructors in poultry husbandry, through the members of their classes, can often make valuable poultry surveys of the region or regions represented in the classes. Such surveys are of value to the students collecting the information. Often valuable suggestions are given them which will lead them to become more successful in their own poultry work. They will be able to make constructive criticisms of various methods which they see in use. They will be able to make contrasts between the good and the bad methods on different farms. They will obtain lasting impressions by actual observations which they could not well gain in any other way.

Poultry surveys are also valuable because of the data which are collected regarding the poultry raising in the neighborhood. Such information will be found valuable to the instructor in deciding what points of instruction should be stressed in the class work and in the community work conducted from the school. The information at hand will be valuable in impressing special lessons in poultry husbandry from time to time throughout the course.

Poultry surveys are also valuable to the farmers whose places are included in the survey. The questions asked in the survey will arouse thought in the minds of the farmers themselves. The work of answering the questions will help the farmers. The fact that their answers are on file at the school will help them to think more of the details of their own business and to conduct it more intelligently and thoughtfully than they might otherwise do. Almost every farmer has a pride in knowing that his farm is being studied by an agricultural school or department.

Outline for a Poultry Survey.[3]—The following outline for a poultry survey is merely suggestive. It should be studied carefully and modified to suit the local conditions and to suit the special objects which the instructor may have in view. It may be made broader in some ways, and it may be more in detail in special particulars. It is believed that this outline could be included on an index card, 5 x 8 inches, by using both sides.

1. Name and address of owner.
2. Number of chickens kept.
3. Other kinds of poultry kept. Numbers of each.
4. Kinds of products sold, with quantity of each.
5. What varieties of chickens, pure or grade?
6. Are artificial incubators used?
7. Methods of housing.
8. Kinds of houses.
9. Sizes of houses.
10. Square feet of light in each.
11. Ventilation system.
12. Scratching system.
13. Yarding system.
14. Production of green feed.
15. Are dry mash hoppers used?
16. Are feeds purchased or raised?
17. Kinds of scratch feed.
18. Methods of watering.
19. Do you belong to a poultry club?
20. Is a poultry journal read?
21. Most common diseases and enemies.
22. Losses from these.
23. Are products sold to consumers?
24. To dealers?
25. Through other agencies?
26. Is parcel post used in marketing?
27. Other shipping methods.
28. Do you consider the business profitable?
29. Are accounts kept?
30. Remarks.

Use of Trap Nests in Poultry Practice.—When students are considering the matter of the selection of breeding stock or making studies in culling of the laying flock, the value of trap nests should be demonstrated by actual use. Equip one or more of the small colony houses in the poultry yard with two or three trap nests each. Have the hens all numbered with leg bands. Students who are in charge of each house should be cautioned to collect the eggs frequently. The eggs are to be marked with number of the hen producing them.

[3] See other outlines for farm surveys in Chapters V, VI, VII, IX, X and XII.

Close connection between the points of the culling score card and the results in trap nesting should be shown. Make a list of all the hens by numbering and filling a score card for each hen at the beginning of the trial. As the trap nest record proceeds, compare the records of the hens with the score card made at the beginning. Some sharp contrasts may be developed showing that the judgment was not good. In other cases the judgment shown on the score card will be corroborated by the trap-nest record.

If trap nests are used with breeding pens, the record kept should show not only the number of the hens but also the cock and his strain. The mark on the eggs may indicate both the number of the hen and the number of the cock. This is usually written in the form of a fraction, thus: $^{20}/_{11}$. With pure-bred stock this record is of great importance as indicating pedigree of the egg and the chick to be hatched from it. If eggs are to be sold or used for hatching purposes, such records will be purchased by many poultry breeders.

Value of Study of Trap Nest Work.—In a group of agricultural students a number may be found who have had considerable practice in modern methods of poultry feeding and management. For such students new lines of work should be started by instructors so that these students will have enough valuable practice to occupy their time profitably. In the following paragraphs are mentioned several other lines of work which should be taken up by such students. Perhaps the whole class in some cases will find it profitable to follow such advanced lines of work. While performing these special lines of practice work they should be expected to continue their routine of the daily chores about the poultry yards and to become skilful by continued drill in the correct performance of details.

Percentages of Chickens Hatched and Raised.—While pursuing the daily work of the poultry yard and conducting profitable projects, students working as individuals or in groups should determine the percentages of eggs hatched by hens and by incubators. The numbers should be compared at the same time of year and under similar conditions. The percentage of hatch to the total number of eggs set may be determined, both with hens and with incubators. The number of hatched eggs should also be compared with the number found to be fertile by the test at the end of seven days.

The number of chicks raised to the end of two weeks or more should be compared with the number of chicks hatched by incu-

bators and by hens. Only the sound chicks at hatching time should be counted.

Students should be cautioned in the matter of drawing conclusions from these trials. If possible, the results obtained should be compared with the results of similar trials at experiment stations, colleges, and agricultural schools. Conclusions are best when drawn from a large number of trials.

Time Required for Production of Fertile or Infertile Eggs.—If it is thought feasible, trials may be made to determine how much time is required before fertile eggs are layed by hens after the first mating. In view of the fact that poultry raisers are urged to produce infertile eggs for market a large part of the year, the question of how long to make use of the male birds before the breeding season is important.

On the other hand, it is also important to determine how much time is required after the male birds are removed before fertility ceases. When a boy or girl finds no more use nor sale for fertile eggs, say in the spring of the year, how soon may infertile eggs be produced for the general market?

Closely associated with these trials, it would be well for students to demonstrate the value of marketing infertile eggs. Make comparisons by holding lots of both kinds for many days. Compare the results. The conditions for holding may be such as would correspond closely to the ways in which they are usually kept in transit and in stores.

Rapidity of Growth of Chicks of Different Breeds.—Demonstrate by trials which breeds are best for broilers by weighing a bunch of any convenient number of two different breeds. Begin the weighing at one day old. Weigh at the end of each week for a period of ten or twelve weeks. Compare a light breed, as the Leghorns, with a general purpose breed, as the Plymouth Rocks, or with a heavy breed, as the Cochins.

In this trial like methods of feeding and management should be used with both lots.

Preserving Eggs.—Conduct trials in the preservation of eggs in summer for use in winter. In these trials compare different methods of preservation. Water glass, grease, and brine may be easily compared. Be sure to use sterile eggs for these trials if possible. They should be perfectly clean without having been washed. Put them into the preserving material when very fresh, the same day they are laid if convenient to do so.

Problems in calculating the profit from preserved eggs should be worked out carefully. The relative cost of different methods may be compared.

Make a score card for judging preserved eggs in the winter season. Points to be included in this score card would be: Appearance of shell; change in weight; size of air space in the end of the egg; freedom of egg from shell when opened; proper coloration of parts; strength of yolk membrane; consistency of albumen (natural or watery); frothing of whites when beaten; absence of sulfur flavor when cooked and eaten; absence of other bad flavors.

Lice Remedies.—Let students make comparisons of various methods of combating lice and mites. Compare light weight, amber colored petroleums, such as the natural Pennsylvania oils, with sodium fluoride powder. In place of the petroleum, kerosene mixed with lard or vaseline may be substituted. In these trials cost, labor, frequency of application, and permanency of results are to be compared. Make trials in nests, on roosts, on the birds themselves, with both young and old.

Green Feed in Winter.—Try out all the details of the methods of production and management of sprouted oats as a green feed for laying hens and for chicks in the winter season. In the southern states make other trials with the growing of winter greens out of doors for use of these birds.

Winter succulents from root crops and cabbage stored in cellars should be compared with sprouted oats or with outdoor green crops.

In some cases it may be possible to make trials with clover silage, steamed alfalfa hay, and similar preserved crops.

The comparison in these trials should include such factors as convenience, costs, palatability, and results of feeding.

Dry Mash and Wet Mash.—With young chicks or with laying hens parallel trials may be conducted to compare the advantages of feeding with dry mash or with wet mash. Consider the health, cleanliness, amount of labor, frequency of feeding, growth of birds, egg production, and cost.

Poultry Work in Rural Schools.—In the smaller rural schools it may be impossible for a special poultry plant to be maintained. In this case most of the instruction may need to be based upon the home projects of the student and upon trips to nearby farms. Experiments, demonstrations, and special trials can be made on the farms of the neighborhood. These can be performed either individually by students or by the class and instructor together when

time will permit. Let the poultry work form the basis for much of the other class work in the school. Correlate the teaching closely with the English, reading, spelling, drawing, writing, and arithmetic work.

Poultry Work for Town Grades.—In towns and cities where poultry may be kept in back yards and vacant lots, the subject may be made an important one in school for children of the grades below the high school. The best time of year for this work is in the early spring or during the last half of the school year. The school studies in the subject should be founded upon the practice work of pupils at their homes. Each student should be expected, if possible, to conduct some kind of poultry project during the time he is pursuing this subject at school.

Let the school work be well illustrated with pictures, charts, and drawings of plans of building. Have samples of feeds. There should be exercises with eggs brought to school for grading, eggs to be preserved for winter, chicks or adult fowls to be examined for mites or lice, others for judging and for teaching methods of culling, etc. Let much of the school work of the class in other subjects be based upon the poultry projects of the members of the class.

Many difficulties often arise in attempts to conduct poultry projects in cities and villages. The danger of hens scratching up gardens or in other ways vexing neighbors is often a great stumbling block for those who wish to keep poultry. A number of suggestions may help to solve this difficulty. Gardens and poultry can be made to harmonize with each other if the owners are willing to make them do so.

1. Laying hens and young chicks may be confined in small yards much more than poultry keepers often believe.

2. During the early garden season when fresh seed beds are planted, confine the birds almost constantly. They may be allowed to have a few minutes run each evening just before roosting time. Then they will eat grass and pick up worms which their appetites crave most. They will seldom stop to scratch or dust themselves in flower beds or vegetable gardens at that time of day.

3. Put brush from tree trimmings over the freshly planted seed beds where poultry love to scratch. After the ground has settled and the plants are large, the hens will do less damage.

4. Teach your neighbors to remember that hens should be allowed in gardens before planting and after the gardens are large enough to be little injured. They pick up many cutworms and other insects that might injure gardens.

5. When crops are ripening, if they are attacked by poultry, keep the birds confined, at least fenced away from such crops. Tomatoes and grapes often require protection from poultry during the ripening season.

6. A few eggs or an occasional broiler given to a complaining neighbor often settles an imaginary difficulty.

Short Courses in Poultry Husbandry.—Schools and colleges often find it advisable to offer short courses in poultry husbandry. These courses should be well planned to suit the conditions of those who are expected to attend. Courses for one or two weeks are sometimes planned in counties or smaller neighborhoods. A few of the most important features of the business should be selected to be stressed during the short course. These topics may be feeding for the winter egg production, proper housing of poultry, enemies and parasites, and culling out the drones. Select such topics as are most important for the region. It may be that pure-bred poultry and study of breeds should be considered before all other things.

All of the lessons in such courses should be in the nature of experiments, demonstrations, and practice work. Theoretical matter disconnected from these should be given no place in short-course instruction.

In college short courses lasting for a number of weeks the choice of topics may be much greater, but the principles already given should be followed. Omit theories and give much practice. Students may be taken to farms where good practices are followed. There they may gain many valuable lessons by observation and by learning the best methods of successful poultrymen.

A Typical Poultry Lesson.—Suppose that at a preceding meeting of the class the subject assigned was "Culling the Laying-Stock." Each member of the class may have been given special assignments to read in the preparation of the lesson. These assignments may have been to certain bulletins and books in addition to the textbook which the students may be using. Each member of the class was handed a copy of a culling card on which the points for culling are given (Lewis, "Productive Poultry Husbandry," Chapter XXX). Each student is expected to go over the points of the culling while studying the references assigned to him.

On the date of the recitation, to-day, a coop of hens of the flock should be in the laboratory or recitation room. Each student is asked to take one bird and go over the points of the culling card. One by one the students are called upon to make criticisms of the bird in hand. If desired, two students may be allowed to work on the same bird. One or both are then called upon to criticize the bird. One may give the bad points and the other the good points. Birds may then be exchanged with other students and a second card used. Instead of using a second card the first card may be passed

to the second pair of students with the bird. The second pair then go over that card with that bird and decide what changes they would make in the former record. Changes are then called for by the instructor. These are then discussed.

After this each student may handle a number of the birds, particularly those which have been pronounced good in certain points, and others that are bad in the same corresponding points, as the width between pelvic bones and distance from keel bone to pelvic bones.

Opportunity should be given to all students to learn thoroughly all of the important points in culling by the handling of birds and discussion of points. Have important features repeated and drilled upon at the close of the recitation period until the slowest members of the class have learned them thoroughly.

Reading Assignments for Students.—There is a large and growing amount of valuable reading matter on the subject of poultry husbandry. Much of the old-time matter based upon theories which were without scientific basis are now being displaced by valuable discussions of practice founded upon modern biology.

Students making a special study of poultry husbandry in colleges, training departments, and high schools should be encouraged to form habits of reading such valuable literature as comes within their reach. A number of experiment stations are sending out valuable bulletins dealing with poultry problems. These may be either assigned to individual students or may be left on reading tables where students most interested can make good use of them. If knowledge is gained in this way voluntarily, it is as valuable to students as any study they can pursue.

Things to Discover in Poultry Husbandry.—In this chapter several paragraphs have been given on things to discover by trials in poultry husbandry. There are always many points which students working with poultry will find out for themselves in a new way. Many of these points will really be discoveries to those students although they may have been known by others before. Among these points may be mentioned: Symptoms of diseases, remedy for diseases, curing of bad poultry habits, methods of feeding or other management, good and bad features in marketing, methods of advertising, mistakes in old theories, and new methods of doing many things.

Poultry Observations.—Teach students to bring up in class observations which they have made with their poultry flocks.

There are many points which require constant attention of poultry keepers. Habits in careful observation on the part of beginners should be encouraged while they are studying the business. A few suggestions on these points are here given:

(1) How soon after hatching do the symptoms of white diarrhœa begin? (2) At what age do chicks show a desire to roost on perches at night? (3) How soon after thoroughly oiling of roosts may mites begin to appear? (4) What influence do nest eggs have with laying hens? (5) When do young stock on free range begin to roost outdoors instead of indoors? (6) How many nights are required for breaking birds from roosting out of doors in the fall? (7) What conditions of the yard seem to develop gapes? (8) What relation seems to exist between cholera and wet mash feeding?

Things to Do in Poultry Husbandry.—Teach students well how to do the many operations in managing poultry properly. Teach how to run incubators. Teach how to trim lamps. Teach how to transfer chicks from incubator to brooder. Teach how to mix poultry rations. Teach how to feed little chicks without causing diarrhœa. Teach how to keep brooder chicks warm without smothering them. Teach how to fix the litter for laying hens in which to supply the scratch feed. Teach how to paint roosts and nests with oil to kill mites. Teach how to spray for disinfecting houses. Teach how to caponize. Teach how to dress broilers. Teach how to plump broilers. Teach how to pack broilers. Teach how to cull layers.

Things to Solve in Poultry Husbandry.—Troublesome problems often present themselves to poultry breeders. To solve these is often a puzzle. The attention of students should be called to these puzzles frequently so they will get into the habit of solving them and gain ability to do so. Some of the poultry puzzles are suggested here:

1. Find the cause of diarrhœa in little chicks and stop it.
2. Why do young growing stock sometimes refuse to eat and "go light"?
3. How can you best cure a broody hen of her fever?
4. When an attack of gapes is discovered should the poultry premises be entirely moved or should other remedies be applied?
5. How can you best solve the problem of supplying succulent feed in the winter season?
6. How can you best prevent the flock from in-breeding?
7. From which hens should eggs be saved for hatching?
8. How late should you continue the hatching of chicks for next year's flock?
9. What enemies are devastating the outdoor brooders or robbing the roosts?
10. How can you best prevent attacks of crows and hawks?
11. When prices of feed are high what feeds are best to purchase?
12. When objectionable points are found in breeding hens, determine the best mating to solve the difficulty.

Poultry Reference Books.[4]—The reference library should be supplied with many good reference books on the subject of poultry husbandry. A number of these are published and a rather complete collection should be obtained if possible. Most of them differ considerably from each other, and there will be little serious duplication if all of them are secured for reference work for students.

These should include all the general books which are planned for general reference or textbook purposes. In addition to these add books on poultry diseases, history and descriptions of breeds. Probably the least desirable books are the old-style publications which give the personal experiences of unscientific breeders of poultry, some of these although still published are of little value to the modern student of agriculture.

Bulletins on Poultry.[4]—The farmers' bulletin series of the United States Department of Agriculture includes several on this subject. The special poultry bulletins issued by the Division of Poultry Husbandry should always be available for reference. Obtain also poultry bulletins from a number of the state experiment stations, particularly those stations which have strong poultry departments.

Poultry Journals and Catalogues.[4]—Have on the reading table or reference shelves the leading poultry journals of the country. Secure also farm journals having good poultry departments in each issue. From time to time send for the catalogues of dealers in poultry supplies, such as incubators, brooders, and other poultry appliances and instruments. In the hatching season obtain catalogues of breeders of pure-bred poultry. The addresses of these may be obtained from advertisements in poultry journals.

EXERCISES

1. Make a list of a number of contests to be entered by students while pursuing their poultry projects.
2. In the list of equipment for teaching poultry husbandry select those items which could be made by the members of the class. Make some of this equipment yourself.
3. Make a long list of poultry laboratory exercises and perform some of these.
4. Conduct a poultry trip for studying a modern poultry farm, making an outline for this trip in advance.
5. Prepare a pen of white poultry for show purposes.
6. Conduct a poultry survey for a small area; then revise your outline for such a survey to be used in the future.
7. Practice using trap nests with a small flock of hens.
8. Conduct an investigation to determine the percentage of chickens hatched and raised in a certain community.

[4] See also Chapter XVII.

9. Make a study to determine the time required for the production of fertile or infertile eggs.

10. Make a trial to compare the rapidity of growth of chicks of two breeds.

11. Make a list of ten or more exercises suitable for use in a farmers' poultry short course.

12. Outline several typical poultry lessons.

13. Make a score card for examining and judging incubators.

14. Make another for brooders.

15. Make another for laying houses.

16. Make a list of good topics for debate in poultry husbandry (see debates in Chapter XI).

QUESTIONS

1. State the specific aim in a course of poultry husbandry.
2. State what you would include in a course in poultry husbandry.
3. Give a list of equipment for teaching poultry husbandry.
4. Describe the class work in this course.
5. Tell of the importance of review work in this subject.
6. Give a list of the main laboratory exercises in this course.
7. What poultry trips would be suitable for the class in your region?
8. Why should there be a good outline made before the trip is taken?
9. Give the chief points to be included in this outline.
10. Why should students be encouraged to participate in poultry shows?
11. Why should the laboratory work be closely related to the project work?
12. Mention some specific values in a poultry survey.
13. Give a list of points to be included in the questionary.
14. Why should students be encouraged to use trap nests?
15. Why should students keep records of the percentage of chicks hatched and raised?
16. What things will influence the time required for the production of fertile or infertile eggs?
17. How does the rapidity of growth of a breed of chicks influence the value of that breed for broiler purposes?
18. Give the points in a score card for judging preserved eggs?
19. What values would you place on these points?
20. Why should students select the simplest and best remedies for lice and mites?
21. Give a reason for studying the production of green feed in winter.
22. Describe a trial for comparing wet and dry mashes.
23. Give suggestions for conducting the poultry work for rural schools; for town grades.
24. Why should teachers of poultry husbandry be trained in all the poultry laboratory work?
25. Mention twelve good exercises to be performed before a farmers' poultry short course.
26. Outline and criticize a typical poultry lesson.
27. Give an example of good reading assignments in this subject.
28. Give a list of discoveries to be made in this subject.
29. What poultry observations should you encourage students to make?
30. Give a list of important things to do while teaching poultry husbandry.
31. Give a list of things to solve in this subject.

CHAPTER IX

HOW TO TEACH HORTICULTURE

"The specific aim of the work in horticulture is to enable young people to obtain such a knowledge of the characteristics, propagation, culture, improvement, harvesting, storage, marketing, and use of the principal local vegetable and fruit crops as will prepare them for success in vegetable and fruit raising."
—Report of Committee on Agriculture of the N. E. A. Commission on Reorganization of Secondary Education.

THE subject of horticulture as here considered includes the study of orchard fruits, small fruits, vegetables, flowers, and orna-

FIG. 59.—Teach students to make root grafts as a winter laboratory exercise. (J. A. Cederstrom.)

mental plants. In many schools this subject is taken up as a one-year course or as a half-year course. This is particularly true in high schools. In junior high schools having only two years of agricultural work the subject of horticulture is usually a part of the one year of plant life.

Content of the Course in Horticulture.—This will necessarily vary somewhat in different schools according to the importance of horticultural products in the particular section of country. In practically all sections of all states there should be considerable interest in nearly all of the divisions of horticulture. Some plant propagation by means of grafting (Fig. 59), budding, layering, division of roots, and by seeds should be given in the course.

Probably most of the vegetable gardening should be taught from

the standpoint of home gardening (Fig. 60) rather than commercial gardening. This, however, will vary in different sections. If there be a good market for garden products near by, students should be taught to grow products for this market. In this case the number of kinds of vegetables may be more restricted than

FIG. 60.—Two good kinds of projects in gardening, beans and early potatoes. (R. A. Moontey, New Hampshire.)

when the general home garden is the main object. Whether to include in the vegetable garden the extensive growing of Irish potatoes, sweet potatoes, and corn is somewhat doubtful. If students have conducted projects with these in a course in field crops, they may be omitted from the vegetable garden work.

The orchard work should include all of the fruits which have been or could be well grown in the climate and soils of that region. If the soil be too light, apples and some types of plums may be

omitted, but other types of plums and peaches should be stressed. If the region is suited to apples, pears, and cherries, more stress may be given to them than to peaches. The choice between sour cherries and sweet cherries should be largely decided by the conditions of soil and climate.

In choosing what small fruits to include in the course we should again decide which ones are well adapted to the region. In northern states all of the bush fruits should be included. Strawberries and grapes can be grown in nearly all sections of the country. In the southern states Muscadine grapes may be added to the vineyard besides the bunch grapes. The bush fruits, except currants and gooseberries, are well adapted to the southern states.

Nuts are usually better adapted to the South than to the North, though black walnut and some other nut culture may be studied in northern states if the local interests warrant it.

The study of the home wood lot should be taken up in this course and may include nut culture. In the North sugar production should be an element in the study of home wood lots, while in the South the growth of English walnuts, pecans, and other nuts may be considered in connection with the home wood lot.

Beautifying home grounds is an important phase of the study of horticulture in almost all parts of America. What to plant and how to plant for the beautification of home grounds, school grounds, highways, and all public places should be considered here—trees, shrubs, vines, flowers, and lawn grasses.

Limitations of the Course.—The amount of matter to be included under the subject of horticulture in any school should be governed largely by the amount of time which the student may devote to the subject.

If only a half of the school year is devoted to the whole subject of horticulture, a number of the vegetables which are rare or least suited to the region should be omitted. The time devoted to plant propagation should be rather restricted and should be directed towards those lines which would be most practical for the members of the class. If the subject of seed testing has been considered in connection with field crops or other plant husbandry work—*e.g.*, in botany, it may be omitted from this course. Even the work in orchard fruits may be chiefly directed towards one or two kinds, for example, peaches and apples or plums and peaches. The work in small fruits may even be confined if necessary to strawberries, one of the bush fruits, and grapes.

Attitude of the Class Towards Topics Selected.—The members

of the class should feel that the topics which are selected for study in this course are ones which will give the greatest returns in their projects while attending school and afterwards. The time devoted to the subject of horticulture in any school is usually too brief to include everything which might properly be called horticulture. The growth of cranberries, for example, may be made interesting to any class anywhere, but it will be far more interesting to the class in some region where cranberries should be grown and can be grown with much profit.

A good guide in determining the interest and importance of different phases of horticulture is to select first, if possible, the projects which the members of the class are to pursue. These should be studied and made the chief center of thought by all the members of the class. Local surveys may be quickly made even if they are not intensive at first. These will indicate what horticultural subjects are of most local importance, and what should be stressed with the members of the class. Arrange all these topics to suit to the season of the year so far as possible.

Methods in Horticulture.—This is not an abstract subject and should never be taught as such. There are so many materials and things to be handled and used that some of these should always be at hand for study by the class either during the recitation or laboratory work.

Practicums, exercises, field trips, study of markets, and other practical phases should always be uppermost in the mind of the instructor. The study of subject matter itself should always be based upon these other phases of work. Horticulture lends itself better to the practical phases of teaching than does almost any other division of agriculture. Pruning, spraying, thinning, propagating, transplanting, cultivating, fertilizing, harvesting, packing, storing, and marketing all come so rapidly before the live instructor of the subject that he will really dislike to give abstract lessons to his classes.

Equipment for Teaching Plant Propagation.—There should be in any school laboratory a few simple things for teaching grafting (Fig. 59), budding, and propagating by other methods. If the school does not own its own grafting knives and budding knives, members of the class may be expected to supply themselves with these.

There should be in the laboratory or somewhere about the school a suitable place for storing boxes of apple seedling roots, scions, and other fresh materials. These should be so kept as to be

in a cool, moist condition for a number of weeks and be ready for use during the winter when needed. Sawdust or sand for packing is necessary.

There should be shallow boxes about 1½ by 2 feet over the top and four inches deep for use in starting hardwood and softwood cuttings, sprouting seeds, and transplanting seedlings. These trays or "flats" may be made by the students. Plants for producing these cuttings may be grown in the windows of the laboratory or may be obtained when desired from the homes of students or neighbors. Hardwood cuttings may be taken from shrubs or from plants out of doors during the fall or early winter and stored in such places as have been mentioned, where they may be left to callous. Students should, of course, make these cuttings for practice work.

A laboratory where horticulture is to be taught should be supplied with many samples of spraying materials. These should include the ingredients of Bordeaux mixture and kerosene emulsion, soluble oils, lime-sulfur, nicotine sulfate, and all poison sprays, such as Paris green, arsenate of lead, and iron sulfate. Add to this list all patent preparations that may be found on the market which seem practical for use. Have several forms of spraying apparatus, including a bucket sprayer, a knapsack sprayer, a barrel sprayer, and one or more small hand sprayers. If larger spraying apparatus is needed, it is, of course, not to be kept in the main laboratory.

Pruning tools should be ready for use in the laboratory. These will include hand shears, double-handle shears of several kinds; long extension pruners of one or two lengths may be necessary. Pruning saws and heavy dehorners should be shown and be ready for use. Utensils and materials for making grafting waxes, for waxing grafting cotton, materials for painting tree wounds, etc., should be available in the laboratory. In making wax heat is necessary, and a burner used in other agricultural exercises may serve the purpose.

In the teaching of horticulture it is advisable to teach the mixing and application of fertilizers for both general and special purposes. Fertilizing materials for illustration and for mixing should be at hand in the laboratory. These may be kept in boxes or special bins made for the purpose. Samples may be kept in large jars, where they may be easily examined and used in such experiments as testing their solubility.

Samples of orchard soils of various kinds, particularly from

those regions where the students live, may be kept in bins or soil cans. These soils may be used in the propagation work in the trays already mentioned. Sharp sand should be available for use in flats when cuttings are to be rooted and for use in other exercises.

The laboratory should be provided with insect specimens and with examples of their work on trees, shrubs and other plants; specimens showing the injury from diseases should also be available. Examples of good and bad pruning may be mounted on cards for quick reference when needed in the classroom.

Outdoor Equipment for Teaching Horticulture.—On the school grounds, if possible, it is well to have ornamental plantings of shrubs of many kinds, and vines which climb on trellises, on wood, and on masonry surfaces. It is best to have perennial vines as well as annuals. There should be grass lawns where the care of lawns may be taught.

A small orchard, including a few of each of the kinds of fruits suited to the region, should be grown on the land laboratory of the school. If this is impossible let a young orchard be started on a neighboring farm with the privilege of study and work by the school. It is well, if possible, to have orchard trees of different ages for student practice. These will offer different problems in pruning, spraying, fighting borers, etc.

A young or an old vineyard, or both, should be either on the school land or near by, for practice work. This vineyard need not be large, but the size may be suited to the available land and to the number of students likely to be pursuing the work.

Bush fruits of the types suitable for the region may be grown either on the school land or on the neighboring farm. Not many of these are needed, but a few blackberries, raspberries, and perhaps currants and gooseberries should be handy for the teaching of horticulture. Have also, at least, a small patch of strawberries to teach methods in controlling the runners, propagating the plants, mulching, cultivating, fertilizing, etc.

A School Garden.[1]—A part of the land laboratory should be devoted to a school garden. The size of this may be governed by the method to be followed in conducting it. If each member of the class is to be assigned a definite area, a certain number of rows for his individual care, the area may be much larger than if only a coöperative garden is to be managed. If the area will permit, the individual management with a few rows is much better than the

[1] See also Chapter XIV.

coöperative plan. Conducting the vegetable garden exercises on neighboring farms is usually not satisfactory. Of course, students may pursue their home projects in vegetable gardening. But there are so many lessons which should be taught in the garden itself with the whole class present that a small piece of land, planted with garden crops, should be near by and entirely under the control of the class. If home projects are conducted by individual members of the class, the area devoted to the school garden may be very small.

Garden Tools and Implements.—A suitable place for keeping the necessary number of rakes, hoes, spading forks, markers, twine winders, lines, planters, and cultivators should be either attached to the school building itself or should be erected as a separate small building. Sometimes the basement of the school building itself may be used; a large empty room or closet may serve the purpose.

All the tools should be numbered. These numbers may be burned on the handles, stamped with a steel die on the metal parts, or the numbers may be painted on the tools. Have racks and holders suitable for keeping the tools in order. The places may be numbered to correspond with the tools kept in them. Order in their arrangement and storage should be taught to all students for the sake of their future habits.

Storage places for seeds may be arranged in the same room where the tools are kept, provided, of course, that mice and weevils are excluded by the containers. This room should also contain hand sprinklers, garden hose, and other watering apparatus. The room also serves as a suitable place for keeping drainage tools, samples of drainage tile, flats for propagation of plants and growing of seedlings, and other special garden and orchard apparatus.

Hotbeds and Coldframes.—In some secluded spot protected from the north and west winds by some building, hedge, or row of evergreens, the students may be taught to build hotbeds and coldframes (Fig. 61). The framing materials may be so put together each season that they may be easily knocked down for storage until another year; thus each class will have practice in the details of construction of the frames. Glass sashes must be provided, of suitable size to cover the frames. The sashes and framing materials may be stored from one season to another in the garden house where the tools are kept.

Deep pits constructed of wood or concrete are of great value in

keeping over winter plants which will be suitable in the laboratory during the winter. Bedding plants and stocks for producing house plants and flower beds may be often kept over winter in deep flower pits.

Some dry cellar space, either at the school or the instructor's home or perhaps at the home of some neighbor or student, should be used for the storage of roots of cannas, caladiums, dahlias, and other bulbs which are taken up in the fall. Garden and orchard products may also be stored in such a root cellar.

A School Greenhouse.—Very few instructors teaching agriculture below college rank are provided with a special greenhouse for horticultural teaching (see Chapter XV). A few high schools

FIG. 61.—Group work in making hotbeds and coldframes. The equipment of the school is improved and the students gain valuable experience. (A. A. Pryor.)

may find it possible to erect small greenhouses; but when funds are limited the expense of providing and maintaining such a structure should be avoided. Most colleges teaching agriculture conduct greenhouse work. They have students that expect to follow some special line of horticulture involving the extensive use of glass. Where vegetables are extensively grown in the winter under glass, and where special crops of flowers are grown for market, instruction in greenhouse work is important.

Class Work in Horticulture.—Old-fashioned lecture methods of teaching, in which the students are expected to take down the thoughts of the instructor, are not well suited to the subject of horticulture. Lesson assignments may be made in advance and a study period should be used by the student. There are many books and bulletins on horticultural topics which should be used in making references for looking up topical assignments.

This subject lends itself well to the topical method of conduct-

ing the class work. A lesson in horticulture may easily be divided into a number of small topics. These topics may be assigned to individual students to be carefully prepared during the regular study period and reported to the class at the next regular time. A topic is sometimes assigned to more than one student; but different references are then given to each, so that the thought of different authors may be presented at recitation time. Each student appreciates that he is pursuing a different line of thought from

FIG. 62.—Let students learn the limits of spray outfits that may be too small for home orchard work. (S. R. S., U. S. D. A.)

the rest, and will do the work with much more interest and recite with a better spirit than if all the topics are assigned to all the class.

During the study period the references given at the time of the assignment may be supplemented if necessary by the instructor in charge of the study-room at the time. Students should take such notes during their study as will enable them to present to the class the matter which they have read.

During the recitation the students are called upon in the order which will most clearly and practically develop the whole lesson in the mind of the members of the class. By practical order here is meant the order of procedure as it would be followed in conducting the work in a project at home. Each student should be trained in so

clearly presenting his topic that all the members of the class will get the important thoughts on that topic. He should then be asked to impress on the class the points which should be stressed or which are most important for them to remember in their work. If two students have the same topic, the second should be asked to emphasize or to supplement the first report. If, for example, the first student has reported upon the purposes or methods of a winter mulch for a strawberry bed, the second student, to whom was assigned the same topic, may be asked to review the purposes or methods and the materials used. He may be asked also to give any additional

Fig. 63.—Student spraying orchard for codling moth for the second time, two weeks after blossoms are gone. Teach the use of suitable equipment. (W. V. Longley, Minn.)

thoughts which his authors have mentioned. Members of the class listening to the reports on special topics should be taught to take in outline form such memoranda as will be helpful to them in their work.

An Example of the Topical Method in Horticulture.—Suppose the next lesson is to be on the subject of enemies of the apple orchard and how to control them. Suitable topics for the assignment to individual students may be: (1) The life and damage of the codling moth; (2) methods and reasons for the methods of controlling codling moths; (3) life history and damage of canker worms; (4) control of canker worms; (5) life history and damage of apple-tree borers; (6) the protection of trees from borers, removal of borers, and description of borers; (7) life and damage of the apple aphis, including all forms; (8) methods of controlling all forms of apple aphis; (9) life, damage, and methods of control of tent cater-

pillars; (10) secure sample of apple scab, describe its life, and give remedies; (11) twig blight; (12) bitter rot; (13) frog eye; (14) apple rust and cedar apple; (15) canker and sun scald.

References on each of these subjects should be so extensive that the student will really do some valuable reading and study on his own topic, as treatment in the general text on horticulture is far too brief for a student who is conducting an apple project for profit. He must delve deeply into his topic and be ready to report the best of it to the class. The references on these topics should be to bulle-

Fig. 64.

Fig. 65.

Fig. 64.—A hotbed project at home may bring a good income from the sale of plants such as tomatoes, cabbage, cauliflower, or peppers. (A. W. Hand, N. J.)

Fig. 65.—The profit from a large tomato project is often very great. The crop may be marketed or canned. This student saved hand labor by cultivating the rows both ways. (A. W. Hand.)

tins, books on insects and diseases, and perhaps to special books on the apple. Each student should be instructed to examine specimens which show damage due to these enemies, and to examine collections which show insects in various forms, if possible. Have them bring pictures and specimens to the class to illustrate their reports. Those who report on methods of control should also select the materials which will add interest to their reports.

The Recitation.—In arranging the foregoing topics the order suggested in the assignment may be followed. However, the importance of the enemies in a region should be considered, and the most important should be taken up first. The most injurious insects and their control may be followed by the most injurious diseases and their control. It would be well to follow this lesson with

a series of such topics as methods of spraying, apparatus to be used, and time of application. This whole matter may be then summed

FIG. 66.—The first lesson in pruning may be given in a yard near the school. This can teach the methods of cutting and the use of several kinds of tools. (E. R. Thompson, Okla.)

FIG. 67.—Give students practice in pruning peach trees in a regular orchard. Here they should work somewhat independently—only one or two on one tree. This will develop the principles in the mind of each. (H. R. Naylor, Okla.)

up in the spray calendar which each student may be expected to make and on which all should be thoroughly drilled. Skill in quizzing all of the students on many points may be exercised by the

instructor. The same results may be reached by questioning them from various points of view. For example, students may be asked what insects are controlled by certain insecticides. Or what insecticides should be used for the control of certain enemies. Or what enemies are controlled by spraying at certain times—the dormant spray, the spray after petals fall, or the spray two weeks later, etc.

A Blackboard Exercise Preceding Garden Projects.—Suppose the assignment made was that each member of the class is to draw a plan for his home vegetable garden, including all the kinds

Fig. 68.

Fig. 69.

Fig. 68.—The pruner of a young tree must actually plan its future shape and work in harmony with nature's laws. (H. I. Schnabel, Calif.)

Fig. 69.—When students are pruning an orchard let each work on one tree and not work in large groups on the same tree. Compare Fig. 7. (R. M. Vifquain, Iowa.)

grown in it last year. All are to look up these points: (1) area, (2) shape, (3) direction of rows, (4) reasons for long rows, (5) advantages of using a horse in tillage between rows, (6) list of vegetables for home garden, (7) what varieties of each to grow, (8) quantity of each for their homes, (9) best dates for planting these, (10) what ones to be planted several times and why.

At recitation time let a number of the best plans be placed on the board. While this is being done have lists of the kinds and varieties written on the board, with quantities to be grown. While students are at the board have others tell what vegetables are hardy against spring frosts and what ones are not. Have some tell what dates these should be planted, and how often and how long between plantings of the repeaters. After all plans and lists are

on the board have them judged by members of the class—the plans first. Consider size, direction of rows, length of rows, min-

Fig. 70.—The school may often find grapes to prune in back yards near by. They should be taught the proper pruning for vines on an arbor, as well as for fruit in a vineyard. (E. H. Thompson, Okla.)

Fig. 71.—Grapes on a wire trellis in a regular vineyard give students better practice in pruning. It is like their home project work in many respects. (G. R. Ransom, Okla.)

imum amount of hand work, amount of horse work. Let students who did not go to the board discuss these plans, point by point. Let others discuss the lists of vegetables, quantities, and best

varieties. Let new kinds which were not included be considered, as Swiss chard or New Zealand spinach. Have students repeat the important points in the plans, as to using a horse for the garden work. A little time may be given to consider the saving in growing home gardens.

Laboratory Work.—Much of the time of the classes studying horticulture can be used, particularly during the winter, in practice work and in performing laboratory exercises. This kind of work should have as its object the teaching of how to do things as well as the teaching of lessons in real subject matter.

Do not let any time be spent in the laboratory merely for the sake of consuming winter hours of the students. Let all the exercises have clear, accurate, and definite aims. The instructor should know positively what to expect from his pupils as the result of each laboratory assignment. Select such exercises as will be of real value to the students that are performing them.

The keeping of notebooks on laboratory work should be simple and brief and not voluminous. The exercises may be numbered. The report or notes on each exercise should be on a page distinct from the rest. Do not allow pupils to fall into careless methods in keeping their notes, nor in the performance of their exercises. At first the instructor should work with the students enough to teach them good methods; how to handle apparatus; how to clean up and put away materials used; how to clean up the tables; and how to take notes. Teach students to be systematic and methodical; teach them to be observing, particularly in natural processes. As far as possible they should learn to be independent of each other. If certain students show an inclination to "lean on" other students for their notes and results, give them special caution frequently. Remove temptation from their surroundings.

Laboratory Exercises and Practice Work in Fruit Growing.—(1) Store apple roots intended for stocks for winter grafting.

(2) Winter prunings from the apple orchard may be brought to the laboratory and there cut into suitable lengths for use as scions, selecting only the new wood. Store these in wet sawdust in a cool place.

(3) Labeling should be taught. Let each of the kinds of the scions be properly labeled, using painted wooden labels. Each kind must be tied separately and labels should be securely fastened.

(4) With rosin, paraffin, and tallow make up a batch of grafting wax, and let each student pull some of it as he would taffy candy, greasing the fingers to prevent sticking. It is important to keep the temperature just right to prevent it from becoming unmanageable.

(5) Take one or more balls of No. 18 knitting cotton and wind it into skeins over a book about eight inches long. Cut both ends of the skeins

and tie the strands at the middle and then dip these into melted grafting wax. This waxed cotton may be laid on oiled paper ready for use in grafting and budding exercises.

(6) With apple scions and apple root stocks let all the students practice making many root grafts. These should be counted and labeled and stored away to callous. Let each student become proficient. He should show the grafts to the instructor before they are wrapped as well as afterwards. The tongue graft should be an inch or more in length.

(7) Students should practice budding on willows or other twigs that have been kept in water jars in a warm room until the bark is loose. Budding of this kind is for drill only and the product may be discarded.

(8) Students should perform exercises in the making of Bordeaux mixture.

(9) Learn to test Bordeaux mixture by the yellow prussiate of potash method; also by the knife-blade method; also by the plate-exposure method.

(10) Have lime, sulfur, and the vessel for boiling these and prepare a large batch of lime-sulfur to be kept as stock solution.

(11) Students should be taught to test liquid lime-sulfur with the Baumé scale. They should then dilute a small amount of the solution for winter spraying.

(12) Try dissolving poison materials in Bordeaux mixture and in lime-sulfur solution, using separately Paris green, dry arsenate of lead, and the paste form of arsenate of lead.

(13) Make up a small amount of the stock solution of ammoniacal carbonate of copper. Then dilute this for the summer strength.

(14) An exercise may be tried in the making of miscible oil. Dilute this or some that has been prepared before with the right amount of water for winter spraying.

(15) Indoor exercises in pruning may be planned by digging a number of young trees, bringing them to the laboratory for this work.

(16) Make an apple-sorting table with a wood frame and sloping top. Over this is tacked burlap bagging. It should be depressed enough to hold one or two bushels of apples at a time.

(17) Have apples brought to the laboratory for sorting, grading, and packing.

(18) After the apples have been graded and sorted carefully each student should have practice in wrapping with paper and packing in standard apple boxes. The different styles of packs should be learned by each student by packing apples of different sizes in different boxes.

(19) Learn to pack barrels of apples. Skill in facing may be made a matter of competition between students. Practice heading barrels until students are skilful.

(20) Students may be given good practice in sharpening pruning tools, grafting and budding knives, and tillage implements.

(21) Study the different types of spraying apparatus (Figs. 62 and 63). Let each sprayer be dissected and repack the parts if needed. Let any necessary adjustment be made and the parts be reassembled for use.

(22) Study nozzles of different types. Their effects may be tested in the laboratory with one or more of the sprayers.

(23) Students should become familiar, by careful examination, with the different kinds of scale insects and other orchard pests.

(24) Study specimens of diseases, as black rot, club root, crown gall, canker, sun scald, twig blight, brown rot of stone fruits, scab on apples, apple rust, cedar apple, frog eye, and others.

(25) Exercises in the making up of fruit packages for berries, apples, peaches, etc., may be conducted in the laboratory during the winter.

(26) Study of varieties of fruits should be practiced until all students know the distinctive character of the leading varieties.

(27) Fruit descriptions should be made, using standard outlines and forms made for that purpose.

(28) Practice using score cards for fruit exhibits.

Laboratory Exercises in Gardening.—Winter is a good time for practicing a number of exercises in the laboratory before the season opens enough to start outdoor work. Some of these exercises may be in flower pits, in hotbeds, in coldframes, and in storage cellars.

(1) Let each student make a suitable plan for an ideal home garden having in mind his own place for the garden. These plans should be discussed with reference to soil, exposure, suitability to different garden crops, fences, need of fertilizer, lime, and other points.

(2) Make flats for use in hotbeds later. Box lumber may be used for this purpose.

(3) Plan an exercise in the study of garden seeds of all kinds.

(4) Test garden seeds until students are familiar with different methods.

(5) Study garden fertilizers, forms of lime, and practice mixing fertilizers.

(6) Try experiments with different types of garden soils. Percolation and capillarity may be tried with soils varying in their amounts of sand and amounts of humus.

(7) Try solubility exercises with different kinds of fertilizers.

(8) With soils in the flats have students plant seeds of the vegetables which require transplanting. This should be done at the proper season. Include early cabbage, tomatoes, cauliflower, peppers, eggplant, head lettuce, etc.

(9) Construct frames for hotbeds and coldframes.

(10) Learn to reglaze and putty sashes to be used on hotbeds and coldframes.

(11) Make sieves, using wire netting of different meshes. These are useful in sifting soils for seed-bed flats and pots.

(12) Exercises in the making, painting and numbering of garden stakes and large and small labels may be conducted when these materials are needed.

(13) Students should make twine winders and dibbers.

(14) Simple markers for hand use in the garden should be made in the winter laboratory.

(15) Let students make soft-wood cuttings from house plants such as geraniums, fuchsias, carnations, etc. These may be started to root in flats of sharp sand in the windows.

(16) Practice in making several types of bird houses will impress the lesson of the importance of such things.

(17) Potting exercises may be conducted on potting tables having strips around the sides to hold soils. Try potting cuttings that have formed roots in trays; tomatoes or other seedlings may be transferred to pots. Plants should be moved from small pots to large ones. Give practice in that kind of work when needed.

(18) Students should be taught to cure by drying, brining, canning in tins and canning in glass.

(19) Store garden products for winter. Practice in curing, along with methods of storing, is advisable.

(20) In winter visit store houses and study the products stored there. Exercises in the amount of skrinkage of different products may be conducted.

(21) Study specimens of diseases such as nematodes on carrots, scab on Irish potatoes, rot on sweet potatoes, etc.

(22) Practice the use of the score card in scoring and judging exhibits of Irish potatoes, sweet potatoes, and other winter forms of garden products.

Outdoor Garden Exercises.—(1) Excavate for hotbed frames, install the frames, manure the soil, and cover with glass (Fig. 64).

(2) Install coldframes and cover with cloth or glass.

(3) Planting the seeds or transplanting the plants to hotbeds or coldframes should be performed by all students until they are skilful.

(4) Construct or repair garden fences, paint posts, and use whitewash on fences where desired.

(5) Stake the corners of the garden and stake off the "lands" for plowing. Plan for the back furrow or bedding-up method of plowing.

(6) Learn to lay off garden rows and stake them for future planting.

(7) Practice the ventilating, controlling temperature, and watering of hotbeds, coldframes, and flower pits.

(8) In early spring practice raking lawns, manuring and reseeding spots where the sod is weak, repairing terraces, and correcting drainage.

(9) Give drills in pruning shrubbery, planting and transplanting shrubs where needed.

(10) Repair and build walls, roads and curbings, and other edgings.

(11) Erect an overhead irrigation system or install other forms of garden irrigation.

(12) Practice making a good seedbed with a hand rake in the open garden.

(13) Under the instructor's guidance line off, plant, cover, and firm soil.

(14) Give practice in transplanting plants to the open garden when conditions are favorable. This should include mulching about the plants with a rake.

(15) Later there should be exercises in thinning of garden rows, cultivation with hand cultivator, identification and pulling of weeds, etc.

(16) Make stakes and practice using them for supports of tomatoes, eggplants and others.

(17) Practice combating enemies with spraying methods, dusting methods, and hand picking. Pruning and removing of suckers and dead parts in the garden should be practiced.

(18) Have exercises showing the best cultural methods for each of the crops grown at the school (Fig. 65).

(19) Instructors should give definite ideas followed by practice in the judging of maturity of garden crops.

(20) Practice harvesting, washing, bunching or otherwise preparing garden products for market.

(21) The instructor should teach students how to sell products; the best methods of marketing should be included. Let students practice until perfect, using the best methods. In the fall repeat the exercises in drying, brining, canning or otherwise preserving garden products for future use.

Outdoor Exercises in the Orchard and Fruit Garden.—(1) Pruning both young and old trees should be practiced enough to make all students skilful. Include as many kinds of trees as you have available (Figs. 66, 67, 68 and 69).

(2) Prune bush fruits, including all that are grown in the region. This should be accompanied by examination of fruit buds and the location of the future crop.

(3) Practice pruning both young and old grape vines. This may be made to include vines which are to be supported according to various systems of trellising (Figs. 70 and 71).

(4) Make cuttings from grape prunings, from bush fruit prunings, and scions from orchard prunings for use in propagation of these plants.

(5) Examine trees, shrubs, and vines for their natural enemies, such as scale insects, diseases, etc. Good specimens of all such materials should be saved for future use of classes.

(6) Practice spraying with miscible oil, lime-sulfur or other winter ma-

terials. Use, if possible, several types of apparatus, such as a bucket sprayer, knapsack sprayer, barrel sprayer, and perhaps others.

(7) Remove borers from peaches, apples, pears, plums, and cherries. This should be practiced until students are familiar with all details.

(8) Let students secure apple seeds from cider mills. Prepare them for planting and plant a row or more in the garden for future use in grafting or budding.

(9) Secure plum pits, peach pits, and perhaps cherry pits for the growing of stocks. Stratify these in the fall for winter freezing.

(10) Plant pits of the stone fruits that have been stratified over the winter for growing of the stocks in rows in the garden.

(11) In June practice budding the stocks of stone fruits and of apple seedling stocks. Use dormant buds from scions which have been held in storage in a cellar in wet sawdust.

(12) In September give similar budding practice, using buds from scions of the current season's growth. In this and in the preceding exercise contests in skill and speed may be conducted.

(13) Let students have practice in propagating plants by tip layering, mound layering, and vine layering.

(14) Exercises in the division of roots can best be taught when plants are being transplanted in the fall or spring. Use red raspberries, blackberries, currants, gooseberries, or any that are available.

(15) Students should have practice in all details of the care and management of a strawberry patch at the school. These exercises should include propagation and setting, control of runners, fighting enemies, judging maturity of fruits for different purposes, harvesting, sorting, and marketing.

(16) Let students have practice in judging maturity of crops of all fruits. Consider the use to be made of the crop in each case—whether to be shipped, sold locally, used at home, or preserved for winter.

(17) An exercise in trellising and tying up grape vines is necessary in teaching these methods.

(18) Practice the sorting and packing of fruits of all kinds. Use various forms of packs, suiting each to the kind of market.

(19) The winter storage of apples includes lessons which should be taught by practice.

Trips to Neighboring Orchards.—Students should be given considerable drill and practice in orchards of the neighborhood (Figs. 72 and 73). There are also many lessons to be studied regarding methods of operation and management by owners. In planning an orchard-study trip let as many of the details as possible be worked out in advance. Have some definite purposes in view in going to the orchard. For example, if the owner of the orchard is to be spraying, the instructor of the class may arrange with him to let the class have a demonstration lesson in spraying. Perhaps the school equipment may be used in the work. The owner of the orchard should, of course, pay for the spray materials used. Probably the farmer would supply the team also if needed.

In planning the trip make an outline of the points to be studied en route, before the spraying begins at the orchard, during the spraying operation, and after the spraying.

Some of the points to be studied are the following: (1) Suitable season for spraying for the purposes in view. (2) Amount of material required for the orchard to be sprayed. (3) Cost of material. (4) Best apparatus to use. (5) Type of nozzle best for the purpose. (6) Conditions of wind and sunshine favorable for spraying. (7) Combinations of material to be used for the insects and diseases of the orchard at this time. (8) Examine the orchard for evidences of insect pests and diseases. (9) Evidences that the orchard has been properly pruned and sprayed previously. (10) Evidences of the forthcoming fruit crop. (11) Proper distribution of spray material. (12) Thoroughness of spraying. (13) Criticisms of the spraying.

FIG. 72.

FIG. 73.

FIG. 72.—Young people are apt to feel overburdened when set to pruning an old, badly-neglected orchard. Have some one state the main principles to be remembered while they are at work. (G. R. Ransom, Okla.)

FIG. 73.—Do not allow such severe "dehorning" unless the tree is greatly devitalized. Compare with the same trees before pruning in Fig. 72.

(14) How soon can results be positively determined? (15) What suggestions can you give to the owner for better results in the future? (16) What further spraying will you recommend for this season?

The class should make a study of the owner's orchard project so far as possible on this trip. Determine his methods of fertilizing, cultivating, and pruning. His whole system of management in picking, packing, sorting, and storing may come in for study if time will permit.

Other Orchard Trips.—A number of orchards in the neighborhood may be visited, but each time a definite lesson and perhaps a new one should be planned. The main purpose of a trip may be

for practice in pruning of either young or old trees. Much time should not be consumed by repeating the same kind of lesson often, but each student should get sufficient practice in one or two trips to fix well one particular lesson or method in his mind.

Spraying with Bordeaux mixture and arsenate of lead after the peaches have formed, for the purpose of fighting curculio and brown rot (Fig. 63), may be a lesson distinct from winters praying with lime-sulfur (Figs. 74 and 75).

Perhaps the orchard trip may be taken at picking time, and then varieties, ripeness, management of pickers, picking utensils, packing methods, and marketing may be objects of study (Fig. 76).

FIG. 74.—Winter spraying of apple trees for San José scale and fungous diseases; home project work, Virginia. (J. B. Roller.)

Trips to Small Fruit Gardens.—Valuable lessons can be learned by studying farmers' projects in growing raspberries, blackberries, or other bush fruits. Special strawberry growers may also be visited. If there are commercial vineyards in the region, trips should be made to study the projects in grape growing. On a strawberry trip, for example, let students take note of the suitability of the crop to the soil; methods of propagation of plants; time and method of setting plants; methods of controlling runners; cultivation; materials and methods of mulching; harvesting; marketing; varieties grown; cost of each of these operations; prices received for fruits; use of by-products, and chief enemies.

Trips to Home Gardens.—One to two trips to well-planned home gardens may be made at different seasons of the year—one perhaps in late spring after the garden is well up, and another in

FIG. 75.—Spraying with lime-sulfur all day in the winter, by boys, is possible only when there is hope for a good profit from the project. Spraying would be easier and more thorough if the pruning were done first. (A. W. Hand.)

FIG. 76.—Students should study in the orchard with the instructor such things as winter killing, frost injury, bud and fruit development, variety differences, needs for cultivation and fertilizing, and need for summer pruning. (C. H. Hanson, Minn., and S. R. S., U. S. D. A.)

the fall before many of the crops have been harvested for winter. During spring trips the points to be studied are: Size of the garden with reference to the number of people in the household; variety of vegetables grown; plan for succession of crops; examples of companion cropping; plan of the garden with reference to cultivation and management; location of perennials, long-season annuals, and short-season annuals; plans for trellising, staking, pruning, spraying, and fertilizing.

The fall trip should consider, in addition to some of the above points, such things as storage, cleaning up garden, fall plowing, winter cover crops, fall garden crops, and results of the year's garden.

Trips to Market Gardens.—In regions where it is possible to find truck growers or market gardeners, suitable trips should be planned to study their special crops, their methods of growing the crops, their utilization of garden areas, systems of irrigation, if used, methods of harvesting and marketing, prices received, yield of crops, maintenance of fertility of soils, composting of manure, transportation problems, etc.

Trips to Study Landscape Gardening.—It is important, when taking trips to orchards, gardens, and other places, to study the problems of landscape gardening along public highways, along private places, and in parks if possible. Much value can be gained by utilizing in this way the time in traveling during all agricultural or horticultural trips.

Different types of landscape gardening may be located and special trips taken to them if time will allow. If so, drawings and notes should be taken and trips should be made as valuable as possible. Places that are improperly planned might be replanned with profit.

An Orchard Survey.—Early in the study of orcharding, or before it actually begins, the class and the instructor should together make a survey of the orchard interests of the region. This may serve as a basis for planning the educational campaigns for the class studies, for the field trips, for practice work, etc.

Questions for an Orchard Survey.[2]—Let questions be clear and direct. They should be so formed as to let the answers be brief and easy. If the questions are on two sides of the card, it need not be large. These may be kept for future study, for tabulation, and

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[2] See topics for farm surveys in Chapters V to VIII, and X to XII.

for summarizing in any way desired. The chief points to be included are here given:

Name.	Address.
Kind and number of trees.	Ages of trees.
General conditions.	Clean tillage or sod.
Intercropping.	High heading or low heading.
Pruning close or slight.	Character of soil.
Slope of land.	Cover crops.
Green manure.	Commercial fertilizers.
Barnyard manure.	Chief orchard pests.
Remedies used.	Largest yields and when.
Methods of harvesting.	Losses from pests not controlled.
Uses of main crop.	Uses of by-products.
Methods of storing.	General criticisms of orchard.
Best points observed.	Bad points observed.

Other Horticultural Surveys.—Make similar surveys for bush fruits; for strawberries; for vineyards; for home gardens; for truck and market gardens.

It may be worth while to make surveys of the ornamental planting done in the last few years on home grounds. This could be very profitable. It should cover the number and kinds of vines planted; places where planted; number and kinds of ornamental shrubs planted; style of planting; number and kinds of ornamental trees planted; number and kinds of evergreens planted; efforts to obtain lawns and the success of these efforts.

Use of Charts in Teaching Horticulture.[3]—A few horticultural charts are on the market and should be obtained by the schools that can afford them. In some cases these are parts of general sets of agricultural charts.

The school should make a number of charts by using photographs, drawings and illustrations, clippings from bulletins and magazines. Have suitable wording on each of these and plan the series before making so that the subject matter of each chart will be unified and not too complex. Such charts are very useful in class work, and community meetings, farmers' institutes, conventions, etc.

Horticultural Lantern Slides.[3]—If the school is equipped to make its own lantern slides or can have them made locally, a number of suitable subjects may be obtained from the region. They will be of much more value than slides from other regions made by commercial companies. Lantern slides purchased from various supply houses, either colored or plain, may be used to good advantage in the school work and in community meetings.

[3] See also Chapter XVI.

Stereoscopic Views and Pictures.[4]—Many horticultural views for use with the stereoscope are sold by supply houses. These cover nearly all phases of fruit growing, garden and landscape work. Usually they show results rather than operations.

Local pictures should be taken with the camera to show operations in all lines of work. These may be taken with a small camera, and may be used either in their original size or may be projected by a reflectoscope, or they may be enlarged and used from time to time in teaching horticultural methods.

Home Projects in Fruit Growing.—Teaching by doing is best exemplified in the home project work. A few suggestions for the topics and scope of projects in fruit growing are here given:

1. Start with a new setting of raspberries and grow the crop for two or three years.
2. Set and grow a patch of blackberries for two or three years.
3. Start and grow a patch of currants or gooseberries, or both, for two or three years.
4. Care for and manage a bearing vineyard for one year.
5. Start a young orchard and care for it two years—apples, pears, or peaches.
6. Manage and care for a bearing orchard for one year, preferably in early bearing life.
7. A short project may consist of harvesting and marketing a crop of peaches for one season.
8. Renovate an old orchard and care for it one or more years.
9. Grow a crop of strawberries for two years. This may be confined to one year by starting one patch and managing a bearing patch at the same time. Similar combinations could be made in the projects with bush fruits.
10. Prune, spray, and care for the home orchard for one year. Let this include all kinds of orchard and bush fruits.
11. Start a nursery of fruit trees and care for it one or two years.

Home Projects with Vegetables.—1. Raise one acre or more of Irish potatoes for profit.

2. A larger or smaller area may be used for similar projects with each of the following: Sweet potatoes, onions from seed, garlic, onions from sets, celery, cabbage, snap beans, garden peas, lima beans, turnips and turnip greens, sweet corn, watermelons, cauliflower, cucumbers, tomatoes, asparagus, and other crops.

3. Raise hotbed plants for sale, and market the crops. This may include any plants suitable for transplanting, as cabbage, cauliflower, peppers, egg-plant, tomatoes, head lettuce, sweet potatoes, etc.

4. Grow garden crops on the same area in succession for one season, as garden peas, followed by snap beans or pole beans. Use any other succession cropping when desired.

5. Grow a general market garden for one season, using as many crops as may be found profitable on the area assigned.

A Beautifying Project.—Plan projects in the improvement of home grounds for the sake of making the place more valuable (Fig.

[4] See also Chapter XVI.

77). Elements in the improvement may include replanting of the yards, planting lawns, trellising when advisable, draining, laying

Fig. 77.—Teach students to beautify their homes. A few trees, shrubs, and vines would make this North Dakota homestead more inviting. (A. A. Sather.)

out and constructing walls, constructing and repainting fences, planting of shrubbery, planting of vines, painting and whitewashing

Fig. 78.—Give students training in planting shrubs, vines, trees, and flowers on the school campus. (A. A. Sather.)

wherever needed. Photographs should always be taken before and after each improvement project. Contests may be run in con-

nection with each of them. Valuations of the farm before and after should be made. The profits from such improvements may thus be determined. Some people make good incomes by buying places, improving them, and selling them again.

A group project may be pursued at the school in planting and otherwise beautifying the school grounds (Fig. 78).

Teaching Horticulture in Rural Schools.—Much of the equipment and land laboratory mentioned in this chapter may be lacking at nearly all rural schools. The practice work, however, may be on farms near the school (Fig. 79). If conveyances are available, the school may be easily taken to orchards, vineyards, and other small fruit plantations. Much of the work of the pupils in the school should consist of their home projects and the lessons drawn from them. The school surveys can be as well conducted by rural schools as by high schools and colleges. The rural school grounds should be improved: Plan and construct roads and walks, select and plant flowers, vines, shrubs, and trees; trellis, prune, spray, and otherwise care for the growing things.

School Gardening at Rural Schools.—It is usually not advisable for rural schools to attempt to maintain vegetable gardens throughout the summer. For small children who do not already know simple garden operations, small plots of vegetables may be grown to teach these methods. The students should continue to practice these operations in their home gardens. Let the lessons given on the school garden plots be instructive and not mere drills or drudgery.

Students should become familiar with the use of seed catalogues. There are new varieties appearing from time to time to which their attention should be called. Let students grow in the school gardens things which have not become familiar to them. In some sections Swiss chard, New Zealand spinach, kohl-rabi and globe artichoke are among uncommon plants which may be worth trying. In rural schools it is important to stress the practice of companion cropping and succession cropping.

Teach Gardening to Small Children.—With pupils as young as the elementary grades much skill in teaching gardening is required. They need to be shown how to do even the very simple things such as raking, making drill rows, dropping seeds, covering, firming the soil, thinning, and weeding.

In the winter time small children may make a model of a home garden on sand tables. Much ingenuity may be used in this work.

The principles of gardening may be developed if some effort is made to do so.

Fig. 79.—The rural school teacher as well as the city grade teacher may supervise the home garden work of students. (T. G. Brown, Wis., and W. V. Longley, Minn.)

Elementary children should have practice in drawing garden plans. Let one line on a paper represent each row of the garden. Then on this row write or print neatly the names of crops to be grown in the

row. They can show what crops will follow others in the season in each row. These garden plans may be used in their home projects, or they may be compared and the best selected for use in planning a model home garden at school for practice in different operations.

Children in the grades will take much delight and get much value from fighting various insects that are enemies of the garden and orchard. Suitable breeding cages may be easily devised for this purpose and may be kept in the windows of the school-room. When the transformations of the insects are observed children will never forget them.

A very good form of exercise for grade children in the fall is the collection of garden seeds in envelopes. Teach the pupils to select seeds from plants which are immune to disease and are in other ways the best plants. Seeds must be properly labeled and after drying may be stored where they will not be attacked by mice and weevils.

In the winter, primary pupils should have practice in seed testing, making pasteboard boxes, preparing tin cans for growing tomatoes, making sieves, flats, and other simple equipment.

Many nature lessons connected with garden materials and specimens should be given to pupils of the lower grades.

Short Courses in Horticulture.—High schools and agricultural colleges frequently offer short courses in horticulture to farmers and others who are preparing to take up such work. The plans for such courses should be very specific. They should be worked out to the minutest detail in advance. A careful study of the subjects to be included in such short courses must be made by the person in charge. Omit nonessentials and do not plan to give the so-called prerequisites or fundamental sciences as would be required for long courses.

Most of the work in short courses should be the art rather than the science of horticulture. Let all lessons be founded upon practices and methods rather than upon theories.

After the subject matter has been planned, then a definite line of methods should be formulated to be followed during the course. Gather together all illustrative material in the way of slides, charts, pictures, materials, and apparatus.

The season of the year will determine largely the operations which can be carried on. Spare no pains to have every operation conducted in the best way, and have as many actual operations as possible. For example, if outdoor weather does not allow spray-

ing, the operations of making and diluting materials and using the apparatus may be demonstrated indoors. The instructors in charge should feel it incumbent upon them to have all lessons thoroughly illustrated and demonstrated to the people who are taking the short courses. No time should be wasted. Many demonstrations can be set up in advance of the hour scheduled, and thus more demonstrations may be given in the same length of time.

Another principle in the teaching of students attending short courses in horticulture is that each lesson must be impressed upon the students in several ways. Better teach the same lessons several times in different ways than to give several lessons poorly. If a student attending a course carries away a few ideas well fixed so that he will actually practice them the rest of his life, the course will have done more good than if the student feels he is getting more than he can remember. No instructor should be allowed to exhibit himself as a walking cyclopedia with many facts to give to his students. He should not try to show off his great amount of knowledge. The best teachers for short courses are those who impress their teaching well by homely illustrations, by well-prepared demonstrations, by practice, by drills, and by applying the lessons to the farm projects of the members of the class.

Types of Short Courses in Horticulture.—Short courses are of many different lengths. They may be offered to adults who can attend only at night for a week or two. Or they may be given for a few weeks both day and night. Or they may continue for a few months in some suitable time of the year when students can best attend. Young and old farmers often find it possible to attend short courses during the winter season. City people often plan to attend short courses in the summer, as at Chautauqua courses.

Horticulture on the Reading Table.[5]—It is well to have on a shelf or on a reading table a few of the best horticultural periodicals that may be consulted from time to time by students and instructors. These should include publications which relate to fruit growing, gardening, landscape work, and nursery work. Some general periodicals which have good departments devoted to horticulture may be included.

Let miscellaneous horticultural publications be placed on the reading table. Many seed houses issue good catalogues and other pamphlets which are worthy of a place here. The spraying com-

[5] See also Chapter XVII.

panies will be glad to furnish their catalogues regularly for this purpose. Obtain also the literature of manufacturers of insecticides, fertilizers, and packages for marketing.

Using Supplementary Matter in Horticulture.—Students may be encouraged to call the attention of the class to the best matter appearing in the periodicals, bulletins, or other matter on the reading table. Some articles may occasionally be assigned as topics for the students to report to the class.

Reference Library in Horticulture.—In Chapter XVII are

Fig. 80.—Students with their instructor laying out and planting a peach orchard. (H. N. Loomis, Mass.)

given the best methods of keeping horticultural books and bulletins. (See lists in Appendix). These should be used abundantly by the students in looking up the topics for studying their individual home projects. They should also be used in preparing practice for recitation in the class-room. They should also be used in looking up principles and methods to supplement the text on all points. Some of them may be helpful in suggesting or giving details of exercises in the field or laboratory.

The reference books and bulletins may be consulted by people of the neighborhood, and in some cases perhaps may be drawn for use at their homes. Much time of the instructor may be saved by referring inquirers to bulletins and books on the reference shelves of the school. Some of these may be led to secure the bulletins and books for their own use at home.

Things to Discover in Horticulture.—Students of horticulture should be induced to discover for themselves many things which

Fig. 81.—Planting young fruit trees on the school land laboratory. Upper, showing how error might arise through the use of a carelessly made planting board. Lower, horticulture class demonstrating to other students a proper method of tree planting. (H. A. Savage.)

the best horticulturists are required to discover. Some of these things are here suggested:

1. When are fruit buds first developed on young peach trees, and where are they placed?

2. Discover the effects on fruit buds and shoot buds of the lowest winter temperature and of sleet storms.

3. Discover how bright sunshine on winter snows may develop sun scald on tree trunks, and find a remedy if possible.

4. Discover the bad effects of high heading of orchard trees; also of low heading.

5. Discover the bad effects of late spring frosts in orchards and vineyards.

Horticultural Observations.—Teach students to make observations for themselves and report them to their parents and to the class. These observations may be connected with their own

Fig. 82.—Students and farmers should be taught how to cure and store sweet potatoes in a house with a good ventilation system. Make a lantern slide of such a subject to show at community meetings. (P. L. Guilbeau, La.)

projects, with the projects of neighbors, along the highways and byways, and on school grounds. Some lines of observation are here suggested:

1. The good effects of winter mulching of strawberries.

2. Make a chart of the observed blooming dates of many varieties of several kinds of fruits. These charts should include dates of the first bloom, full bloom, and last bloom for each.

3. Observe what varieties of individual trees bear heavy crops of blossoms without bearing much fruit, thus observing what varieties will not pollinate themselves.

4. Observe the first appearance of shoots on different plants and arrange a list of those most susceptible to injury by late frosts.

5. Observe in the winter how buds and small twigs are protected.

6. Observe in the fall what plants continue growth until winter; and observe the effects on this of growing winter cover crops consisting of nitrogen gatherers, as clover and vetch.

7. Observe what varieties are most immune to special diseases, as brown rot in the peach orchard and plum orchard; wilt in tomatoes; yellows in cabbage; bitter rot in apples.

8. Determine by observation the effects of special fertilizers on growth and fruit bearing in vegetable gardens; in orchards and small fruit plantations.

Things to Do in Horticulture.—Young people studying horticulture should be taught to feel the responsibility of doing things at the proper time. They should also be taught the most careful and correct methods of doing things. A number of the methods to be taught in the vegetable garden have been mentioned in this chapter. Teach how to lay out orchards (Fig. 80). Teach the very best methods of planting a tree or shrub (Fig. 81). Teach how to dig a tree, bush, or vine to get the best roots. Teach how to transplant an evergreen without disturbing the soil about the roots. Teach how to plant cuttings that are to take root in the soil. Teach how to make cuttings of all plants that will readily reproduce themselves by cuttings. Teach how to prune without the loss of sap. Teach how to topwork fruit trees. Teach how to dig for borers at the proper time. Teach how to protect trees from borers. Teach how to catch rabbits or other enemies of young trees. Teach how to attract the birds. Teach how to prevent birds from eating cherries without killing the birds—by watering and feeding. Teach how to cut sod and lay sod. Teach how to make trellises and contours. Teach how to thin fruit. Teach how to pick fruit properly. Teach how to manage fruit pickers. Teach how to sell crops. Teach how to store crops (Fig. 82).

Things to Solve in Horticulture.—There are many puzzles which present themselves to the horticulturist. Students should learn to solve these as clearly and as correctly as they can. Some of these puzzles are here suggested, but no instructor need try to invent the puzzles. He should watch for them, however, and assign them to students to solve. No better training can be found.

1. How do varieties become mixed in orchards, fruit plantations, and gardens?

2. Learn to name puzzling varieties which present themselves from time to time at the home or on neighboring places.

3. What fertilizers would be best under special conditions of growth or fruit bearing?

4. Should the strawberry patch be kept another year?

5. What methods of rejuvenation should be applied to the old orchard?

6. What would be the best intercropping for the small fruit plantation or orchard?

7. How can intercropping be conducted and yet protect the soil from washing during the winter season?

8. What is the best use to be made of the vegetable garden area during the winter?

9. What cover crops are best for your home conditions?

10. When should the mulch over strawberries or other vegetation be removed in the spring?

11. What enemies are causing certain troubles?

12. What remedies can be used to prevent the production of too small peaches or too small apples?

EXERCISES

1. Make a number of grafts and buds, select the best of each type, varnish these with a thin coat, and mount them on a heavy cardboard for illustration in your class work.

2. If possible, make a collection of grafting knives, budding knives, and pruning knives and mount them on a heavy cardboard for class-room use.

3. Make a collection of examples of good and bad pruning, varnish these and mount them on heavy cardboard for your class-room .

4. Obtain the material and make grafting wax and pull it according to directions in horticultural books.

5. Wind a ball of No. 18 knitting cotton into a skein eight or ten inches long, cut this at both ends and dip in melted grafting wax. The strands are thus made ready to use in grafting and budding (as directed for students).

6. Make a collection of samples of orchard soils and subsoils.

7. Make a list of annual vines and state the kind of surface or trellis to which each is adapted.

8. Make a similar list of perennial vines.

9. Make a list of the native shrubs of your state suitable for use in planting on home or school grounds.

10. Construct a rack suitable for the keeping of garden tools for a class of twelve students.

11. Construct a hotbed or coldframe and start it at the proper season.

12. Read over the twenty-eight lines of laboratory and practice work, in fruit growing, suggested in this chapter and perform as many of these as is practical.

13. Do likewise for the exercises in gardening.

14. Do likewise for the outdoor garden exercises.

15. Do likewise for the outdoor exercises in orcharding.

16. Conduct an orchard survey or a small fruit survey for horticultural teaching and reference.

17. Conduct a trip to study a neighborhood orchard, or some similar trip.

18. Take a number of photographs of horticultural subjects and mount these for class-room use.

19. Make lantern slides of some of the best of these.

20. Plan the details for a year's work in a beautifying project.

21. Make a full program for a three days' short course in fruit growing.

22. Make a lesson plan according to the suggestions in Chapter IV for a recitation in small fruit growing.

23. Make a similar plan for a lesson in gardening.

24. Make a similar plan for a lesson in orcharding.

25. Read the topics for debate in Chapter XI, then make a list of eight questions for debate in horticulture.

QUESTIONS

1. What are the subjects usually included in a full course in horticulture for high schools?
2. In what regions would you give some attention to nut culture? To forestry? To landscape gardening?
3. Why does the work in small fruits lend itself better to home projects than does orchard work?
4. Under what conditions is the reverse true?
5. Tell how to store roots, scions, and other material to be kept fresh for winter practice work.
6. At what season would you have students practice the home mixing of fertilizers for horticultural work?
7. Give a list of outdoor equipment for teaching horticulture.
8. Describe a good way of keeping garden tools orderly.
9. Distinguish between a hotbed and a coldframe.
10. Would you make a school greenhouse? Give reasons for your answer.
11. Give reasons for using the topical method in class-room work in horticulture.
12. Give directions for keeping notebooks on laboratory work.
13. Give a long list of laboratory exercises and practice work in fruit growing.
14. Give a long list of laboratory exercises and practice work in gardening.
15. Give a long list of outdoor gardening exercises.
16. Select from the list of outdoor exercises in orcharding and fruit growing, things which would be valuable in your state.
17. Give a list of points to be studied on a trip to a neighboring vineyard, or to a strawberry plantation.
18. Give a list of points to be studied on a trip to a neighboring orchard.
19. What value can be obtained by taking students on a trip to a good home garden?
20. What good can be gained from a trip to study landscape gardening?
21. Give the chief points to be studied in an orchard survey. In a garden survey.
22. Make a suggestive list of suitable charts for teaching horticulture.
23. Give a list of suitable projects in small fruits; a list in gardening.
24. Suggest a list of home projects in orcharding which could be completed within one or two years.
25. How could a student make a landscape gardening project profitable?
26. Give suggestions for the teaching of fruit growing in rural schools; in town grades.
27. Give directions for teaching gardening to small children.
28. Why should the agricultural school hold a winter short course in fruit growing? Why in home gardening?
29. Give a list of suitable books for the reference shelves in fruit growing; in gardening.
30. Mention things to discover in horticulture.
31. Mention observations to make in horticulture.
32. Give a list of things to learn how to do in horticulture.
33. Give a list of problems to be solved in horticulture.

CHAPTER X

HOW TO TEACH FARM MECHANICS, ENGINEERING, AND SHOP WORK

"The specific aim of the work in farm engineering is to prepare young people so to plan, locate, construct, and maintain farm buildings, fences, roads, and drainage (or irrigation) systems; and so to select, operate, and maintain farm machinery and mechanical equipment as to contribute most highly to the profit and pleasure of farming."—Report of Committee on Agriculture of the N. E. A. Commission on Reorganization of Secondary Education.

Every farmer must from the very nature of his business be a mechanic. It is self-evident that he ought to be a good mechanic. The interest which most students naturally have in mechanical things shows that they can be trained readily and successfully to be good mechanics. High schools and colleges offering general courses in farm mechanics do well to place these courses in the early years of the training.

Content of the Course.—The whole realm of farm engineering, farm mechanics, and farm shop work may be included in this course. Most of the exercises included in such a course are in themselves nonproductive. They are rather a means to an end. They are involved in productive projects with both animals and plants. In the broadest sense this course should include the study of farm machinery, farm motors, farm buildings, rural sanitation, road construction and maintenance, simple blacksmithing, pipe fitting, rope work, land measurement, terracing, leveling practice, drainage and irrigation.

Special Methods in Teaching the Subjects.—In the long courses in high schools and in college courses, principles as well as practice should be so well taught that the students are able to adapt methods to new conditions. After such a course, it should not be necessary for students to work by "rule of thumb." They should understand how to adapt the principles to their own home conditions and projects. For example, when the matter of farm power is being taught, the principles of working problems in belting, pulleys, speed, and power should be well understood.

When rafters for building are being cut, the methods of cutting under all ordinary conditions should be learned instead of following patterns.

In road construction the principles of drainage, foundations,

and wearing surfaces should be well understood. Do not merely learn how to operate in one particular case. In building concrete floors for barns the conditions which will prevent the accumulation of moisture under all circumstances should be learned. Do not conclude that one example will suffice under all conditions.

When studying the repair and adjustment of farm machinery, the principles of transmission and their application in complex machinery should be well understood (Fig. 93). When farm motors

Fig. 83.

Fig. 84.

Fig. 83.—A farm shop-room showing very good equipment. (L. A. Henke.)
Fig. 84.—Iowa students making racks for drying seed corn. (Fonda School.)

are being studied, the principles of the gasoline engine should be so well understood that the student can as easily repair one common form as another.

Equipment for Farm Shop Work.—Schools offering courses in farm shop work should have a lighted room with sufficient heat to allow the work to be carried on even in severe winter weather. There should be simple wood-working benches with vises (Figs. 83 and 84).

There should be a few good carpentry tools, including cross-cut hand saws, rip saws, and perhaps a large wood saw, hammers, chisels of one or two widths, braces and set of bits for wood, a jack-plane, miter-box, framing-square, tri-square, hatchet, drawing-knife, spoke-shave.

For metal working, one forge and a heavy anvil should usually be provided in the school shop. The necessary forge tools should include tongs, shovel, poker. Anvil tools should include a hardie,

one or two types of hammers, cold-chisel. On the wall should be placed a press-drill provided with a set of bits. On the blacksmith bench there should be a good machinist's vise with pipe jaw and anvil back. Have sets of taps and dies. There should be supplies of bolts of several types and sizes. Square, round, and flat steel bars should be ready for use in repair of machinery.

For soldering and tinning, have simple and inexpensive outfits.

For pipe fitting, a die stock and set of several sizes of dies,

Fig. 85.—Students being taught to clean, oil, and repair farm harness. (H. N. Loomis, Mass.)

pipe cutter, pipe wrenches, and supplies of fittings and pipe of such sizes as will be used in various exercises.

For harness repair work, have leather punches, supplies of rivets, sewing clamps, needles, awls, wax, and thread. Provide supplies of snaps, buckles, and other harness hardware of the common sizes.

Equipment for Teaching Farm Power Work.—If possible, provide an old gasoline engine which can be used to take apart, put together, and adjust until all parts are well understood. A gasoline engine should be belted to a countershaft which is belted to various machines for different farm purposes. These may be for sawing wood, pumping water, grinding tools, grinding grain, lighting, etc.

If convenient, have a windmill for the study of its principles and methods of management. This may be omitted in regions where windmills are not used. Besides the common gasoline engine, a gas tractor should be provided if possible. This may be borrowed when it is not possible to own one.

A steam-boiler and steam-engine may be of service in teaching the principles of their operation. Such equipment would be most valuable in regions where such machines are to be used, as in dairying. Have in the shed outside the shop, farm machinery which is available for repair work, the study of adjustments, the replacement of parts, and the measurement of power.

Class Work in Farm Mechanics.—Most of the class instruction should be with the mechanical devices themselves. Demonstrations in testing the power of engines is an example of good material for class instruction.

Fig. 86.—Teach students to make rope halters, different kinds of knots and splices. (L. A. Henke.)

When a class is to be given a laboratory exercise in mending harness (Fig. 85), a demonstration in the methods of doing this with proper explanation and discussion by members of the class should precede the laboratory work. Similar instructions should precede laboratory work in pipe fitting, soldering, tempering, framing buildings, making concrete, and installing watering systems, or lighting systems.

Let all the class work precede or follow the practice and laboratory work. When general principles are to be taught to long course students, these principles may be stated and worked out by members of the class just before or just after the work with these materials (Fig. 86).

Reviews and quizzes upon lessons learned in the actual work in the practicums and laboratory exercises should be given from time

to time. Such reviews will lead the students into habits of keeping their minds upon their work. Students that do not keep their minds upon their problems while at work will soon find they are missing much that other students are gaining.

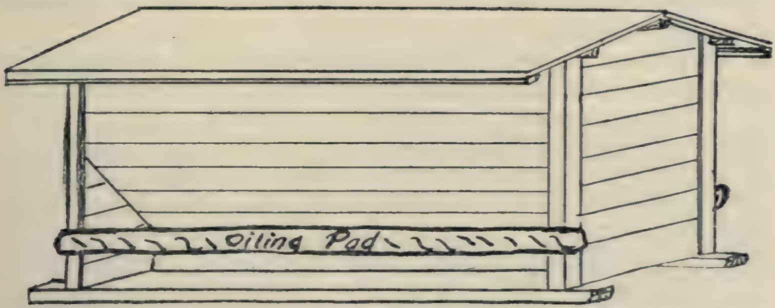

FIG. 87.—A few have combined the hog oiler and self-feeder in their pig project work. Every pig is thus oiled at little expense and trouble. The oiled pad is placed where it will rub their ears, head, and neck when they are eating. (After A. W. Turner in Wallace's Farmer.)

Farm Mechanics and Shop Work.—If students pursuing the course are all from farms or are conducting farm projects, the first and most important lines of shop work should be made up of those

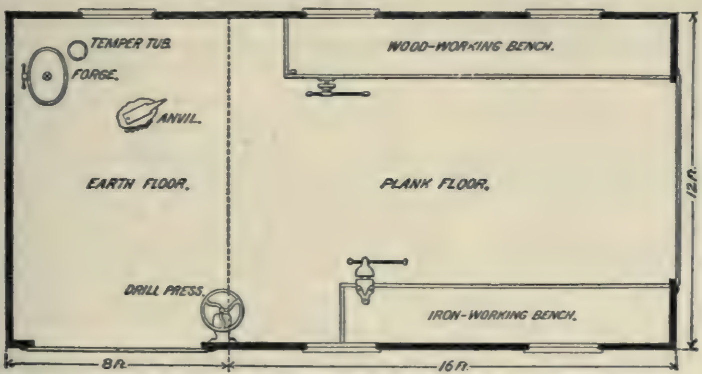

FIG. 88.—Floor plan of individual workshop for a boy's home shop. (U. S. D. A.)

problems with which the individual members of the class are directly concerned. If one or more members of the class are conducting a poultry project and are in need of simple poultry houses such as movable colony houses, they should be taught to construct these, and may do this either at the school during laboratory periods or at their homes as part of their project work. If desired,

all members of the class may be given the same exercise (see figures in Poultry Chapter).

In the following list a number of projects are mentioned, and with each is a list of several kinds of shop or mechanical work to be performed as short exercises or problems by students while pursuing those projects.

In poultry projects: Colony houses, dry mash hoppers, trap nests, common nests, dropping boards, roosts, coops, and brooders.

In dairy projects: Mending and soldering seams of dairy utensils, repairing separators, mending strainers, making new handles, milking stools, feed-record boards, weight-record boards, test-bottle drain-boards, milk-bottle carriers, stanchions for feeding calves, stanchions for tying cows, scale crane for weighing feed, manure trucks, concrete floors in barns, feed chutes in barns, milk houses, ice houses.

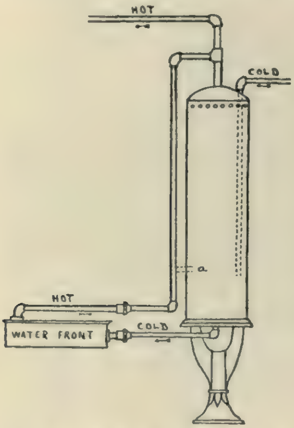

FIG. 89.—A good drawing for a chart to hang in the school shop. It shows how to connect pipes so as to draw hot water as soon as the fire starts.

In beef cattle projects: Feed troughs for corn and other concentrates, feeding sheds, feed racks, weighing pens for scales, manure carriers, concrete floors.

In swine projects: Movable pig cots with or without floors, self-feeding hoppers (Fig. 87), hog oiling devices, dipping vats, slop troughs, water supply lines, hot weather shade cots, mineral pits, shipping crates, hurdle fences.

In sheep projects: Sheds for winter quarters, concrete or other dry floors, racks for roughage to keep wool clean, grain troughs, individual lambing pens, lamb creeps, hurdle fences, dipping vats, shearing platforms or tables, shipping crates.

In mule, horse, or colt projects: Paddocks for mother and foal, box stalls, feed boxes, hay racks, braiding manes and tails, splicing ropes, making rope halters, making or repairing leather halters and harness, splicing chain, making tie posts of concrete, trimming hoofs, making and setting shoes.

In horticultural projects: Making labels, plant trays, garden stakes, twine winders, garden markers, handles for tools; repairing broken tools; sharpening tools; making tool racks; stamping tools

with names and numbers; painting and repairing garden implements; making shipping crates, bushel measures, baskets, fruit boxes, and barrels, hotbed frames, hotbed covers; glazing sash; building storage cellars; making concrete flower pits; potting benches or tables.

In field crop projects: Cribs, bins, and granaries for storage of products; repair of implements used in any project; special devices for particular crops, as seed-corn racks, tobacco harvesting racks,

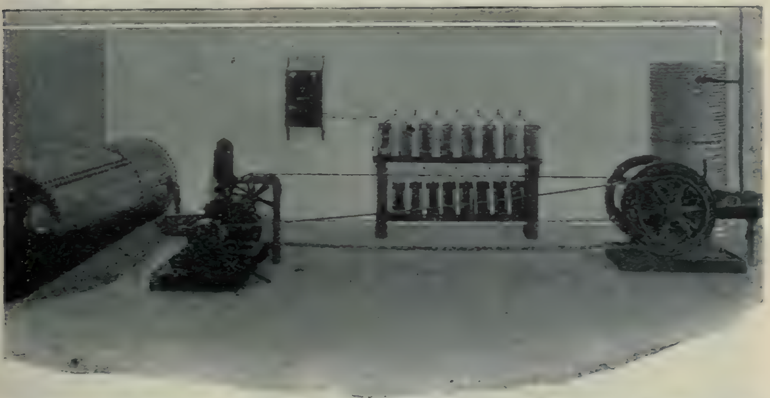

Fig. 90.—Take students to study country lighting and water-pressure systems. They should study them enough to help install them in other country homes. (Fairbanks-Morse Co.)

tobacco barns, deep beds for hauling cotton, grain sieves, bushel measurers, weighing places.

In farm improvement projects: Making concrete walks, repairing and constructing fences, building and maintaining roads, painting and whitewashing buildings, making gates, building implement sheds and hay sheds, repairing gutters, repairing roofs, repairing porch and other floors, glazing windows, repairing chimneys, moving small buildings, installing farm shops (Fig. 88), repairing and installing water lines, making septic tanks, installing kitchen sinks and drains, installing water tanks (Fig. 89), installing bathroom fixtures, wiring buildings for electric current, installing simple lighting systems (Fig. 90), installing farm power.

Work at the School.—Let the bench exercises at the school consist of making things for use on the farm (Figs. 84, 91, and 111). The making of household furniture should seldom find a place in the farm shop course of the school. Have machines brought to the school for study if possible (Fig. 92).

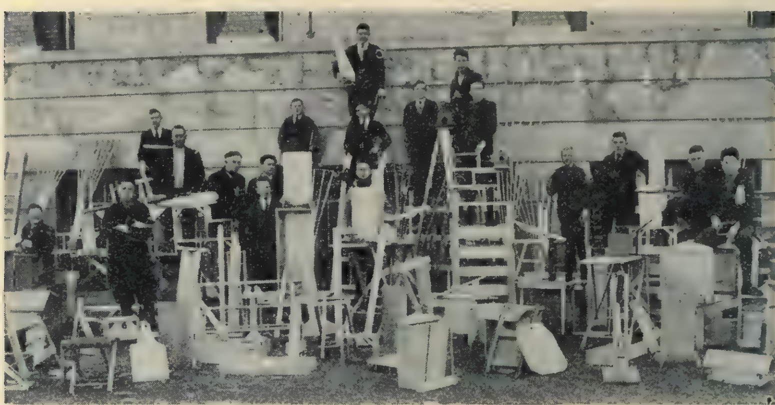

Fig. 91.—Farm shop work in wood by high-school students. The school janitor was an experienced carpenter and was put in charge of this class. (C. H. Winkler, W. Va.)

Fig. 92.—Agricultural students studying several types of planters in the school-room. These were borrowed for the purpose from a local dealer. (L. M. Banknight, S. Carolina.)

Projects in Farm Mechanics and Engineering.—Besides the lists of mechanical work suggested in connection with other agri-

cultural projects above, students may take up projects for the sake of practice in farm mechanics and engineering. Some lines suitable for such projects are:

1. Terracing and contouring of sloping fields and orchards.
2. Tile drainage of land.
3. Planning and installing irrigation systems of various types.
4. Damming streams and harnessing water power for various purposes.
5. Surveying to correct or reëstablish old boundary lines of farms.
6. Measuring lines and areas of all farm fields, and mapping them.
7. Measuring farms and subdividing them for division among heirs.
8. Installing hydraulic rams.

Shop Work with Farm Power.—Students should learn to install the various types of engines with or without the use of counter-

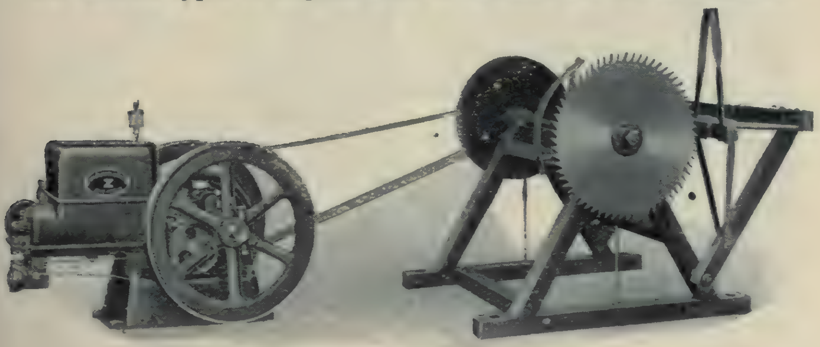

FIG. 93.—Learning to use such machinery helps to keep boys on the farm. (Fairbanks-Morse Co.)

shafts. They should learn to compute the speed of engines and figure the size of pulley wheels to give the proper speed of machines operated with these engines. They should study gas engines in many ways, timing ignition, exhaust on valves, governors, testing the brake horse-power. They should be able to solve gas engine troubles, operate tractors, and perhaps steam-engines and steam-boilers.

Community Surveys in Farm Mechanics.—The chief needs for farm surveys in mechanical lines are:

(1) To be able to take classes to particular places where certain conditions and systems may be illustrated. (2) To be able to refer to particular places in the community where certain mistakes have been made or certain good things have been accomplished. (3) To be able to know where certain apparatus or devices may be located and borrowed for use, or for illustration in school instruction. (4) To be able to know the conditions on different farms, so that the school and instructor may be able to help or advise members of the community more intelligently.

Topics for a Survey in Farm Mechanics.—The following topics, and perhaps others, may be used on the blanks when making a survey in this subject:

Name.
Number in household.
Kitchen sink and drain, or not.
Hot-water system, or not.
Source of water supply.
Best possibility for electric lighting.
List of farm buildings.
Construction of size of silo.
Materials used in walks.
Materials and condition of fences.
Any tile drainage.
General condition of roofs.
Is machinery housed and cared for?
Value of farm machinery.
Name and size of tractor, if any.
Address.
Size of septic tank, if in.
Bathroom equipment, or not.
Water-pressure system, or not.
Best possibility for water system, if none is in.
Farm power in or contemplated.
Size of largest barn.
Concrete floor in barn.
Kinds of roads.
Any farm terracing.
Any land irrigation.
Is painting needed?
Is machinery well repaired?
Age of oldest useful machine.

Aids in Teaching Farm Mechanics.[1]—Sets of lantern slides on such subjects as the use of concrete on the farm, the use of power on the farm, the uses of tractors, manufacture of woven-wire fencing, plans of farm buildings, and others are available, or may be made.

Charts showing the structure of farm buildings, plans of farm buildings, step in construction of silos and other buildings, belting and shafting systems for special purposes should be either purchased or made.

Drawing plans of buildings to be erected by students or others in the community is good practice for students.

Make clippings from catalogues to show types of roofs, shapes of windows, and plans of floors. Mount these on large cards for use in class work.

Physics a Basis for Farm Mechanics.—If students have not made a study of physics at some time preceding the study of farm mechanics and engineering, the elementary principles in those phases of physics which underlie farm mechanics should be taught. In rural schools this may be very simple indeed. In high schools and colleges the curriculum should be planned to allow at least a short period of instruction in physics to precede the application in farm mechanics.

When students are pursuing farm mechanics chiefly from the standpoint of aid for other project work, they need not put much stress upon the principles in physics which underlie the problems in

[1] See also Chapter XVI.

farm mechanics. The how rather than the why is then uppermost in the students' minds. If they are to install electric apparatus without having studied the principles and science of electricity, they will be required to follow carefully the directions for installation furnished with the apparatus. They will be able to do little electric wiring except under the guidance of a competent instructor who is working directly with them.

Trips for Studying Farm Mechanics.—After the reports from community surveys have been examined, a number of trips can be

FIG. 94

FIG. 95

FIG. 94.—Pit silo built under supervision of the school. Students ready to help the owner fill it. (E. H. Thompson, Okla.)

FIG. 95.—Students should learn to use simple leveling instruments and practice terracing and draining of land. (G. S. Boggar, Ark.)

planned to good advantage and with much profit to the class (Fig. 94). Perhaps one trip a week for a number of weeks will be profitable. Suggestions for some of these are here given:

1. Visit a farm having a good gasoline engine (Fig. 93), where a number of types of farm machines are driven by it. Study the belting, countershafts and systems of pulleys. Many problems may be worked out in such a place.
2. Visit a farm where a hydraulic ram has been installed. Study the working of the ram. Determine the fall from the source of water and determine the height to which water is forced. Note the sizes of pipes used, the amount of water received by the ram, and the amount delivered from it. Study the water storage in connection with this water system. Make a drawing of the whole plan. List the possibility in connection with a system where water may be thrown to a suitable height, as with a ram.
3. Visit other interesting water systems and make careful studies of the details.
4. If some one is installing bathroom fixtures, have the class there at the time, if possible, to study the details and methods used. Make drawings to show connections, sizes of pipes, ventilation pipes, gas traps, etc.

5. When farmers want terracing of land, drainage of land, or irrigation systems surveyed and planned, let the class, if it needs practice, do this work for the farmer (Fig. 95).

6. When electric wiring is being done at some place, let all the members, or those most interested, visit the place and study the methods. They should make drawings of the wiring system. Show sizes of wires used, the location of switches, the location of fuses, the openings for light, power, etc. On the same trip they may be able to study lighting and electric power systems.

7. When a septic tank is to be constructed, let the class visit the place and take part in the work. The inflow and outflow pipes should be planned and constructed; the trap or traps used should be located; the drainage pipe and its connection with the house fixtures should be planned and drawn or installed.

8. If the school is not equipped with all desired types of machinery to dismantle, assemble, and adjust, the class should visit places where suitable machines for this work may be used (Fig. 96). Perhaps these will be found at farms in the neighborhood. Perhaps a better place will be on assembling floors of some implement dealer. Students should expect to work diligently and study carefully the implements they are working with. Good machines for such practice are corn harvesters, grain binders, silo fillers, sprayers, engines, tractors, threshers, grain cleaners, and many others. Repairing old machines may be the main object of the trip if it is to a farm in the neighborhood.

9. If suitable places may be found within easy distance of travel, the class should study milling machinery of various kinds. Flour mills, feed mills, fertilizer mills, and others may be considered in this group.

10. If there is to be a demonstration in the region of the use of tractors or other special farm machines, the school should attend if possible (Fig. 97). Make a suitable score card or outline for use in such study.

11. If public road builders or other gangs of men with engines are constructing roads within reach of the class, they should make a lesson of this. They can actually take part in the work or may merely take note of materials used, thickness of layer, grade of road, curve of surface, weight of roller, cost of material, labor and machinery.

School Shop Work Furnished by the Community.—The school should be a center for many kinds of shop work which the community will be able to furnish. The instructor should not agree to have the school do all of the shop work for the community, but he can show his willingness to have the school practice on machines, engines and other equipment furnished by the farms of the region. Many lines of work will be readily found or perhaps offered freely to the school for this purpose. The members of the school may thus be able to study a number of farm implements which might otherwise escape their attention. If possible, let every phase of farm mechanics come in for work in this way. Drill work and skill on the part of the student may thus be secured with little outlay by the school.

If necessary, and if it is found advisable after studying the local conditions, the instructor and class may decide to charge a small fee for repair work done for farmers in the community. Such fees

should be recorded, accounted for, and used in the maintenance of the shop, or in buying more equipment that may be needed. After students gain enough skill they may work on large buildings of the region for compensation and practice (Fig. 98).

Rural School Shop Work.—In rural schools rooms for shop work are sometimes equipped in the basement of the building. In other cases a simple wooden building is erected with rough lumber

FIG. 96.—Students should learn to assemble parts, adjust, and otherwise study farm machinery at the sales places of dealers. (I. H. Co.)

and provided with a chimney to which is connected a stove pipe and perhaps a pipe from the forge.

Equipment for shop work in rural schools may be much more limited than the list given earlier in this chapter. Perhaps the shop work may be confined to wood work, in which case the cost of the equipment is much less than when both metal and wood working tools are to be purchased. If the shop is in the basement, plans should be made to avoid noises which will disturb the school classes above. The work by students should be on simple problems for the farm. They should make things which are not too large to haul

or carry home easily. Do not have them work on exercises merely for the sake of employing their time. They should make useful articles. Many of the things already suggested in this chapter may be used for exercises in rural schools. Select, if possible, those which are connected with the home projects of the students (Fig. 99).

Fig. 97.—Students in farm mechanics should become familiar with the farm tractors of the vicinity and learn how to operate and repair them. (J. A. Wisdom, Mo.)

Shop Work in Town Grades.—If graded schools in villages and cities are equipped to do simple shop work, the exercises may be confined chiefly to wood work and the simple forms of metal work where expensive tools are not required. Exercises with rope (Fig. 86) may be performed to good advantage. Students may make articles which are closely associated with their lives in town or in surrounding country. Simple articles may be made first: Make bird boxes (Fig. 100), plant trays, hotbeds, chicken coops, and

any articles that will be useful on the premises where children live. Some concrete work may be offered (Fig. 101). Let students do the mechanical work connected with their home projects. For lists of these, see earlier pages of this chapter.

Farm Mechanics for Short-Course Students.—As many of the students attending agricultural short courses are usually mature in years, they should not be expected to spend much time in learning fundamental principles underlying the exercises upon which they are to work. Let the time be spent making useful things, particularly of a character which will naturally appeal to students of mature years such as hog cots, colony houses, repairing farm

Fig. 98.—If such a residence is to be built, the high-school students, if under a special instructor, may help in its erection. (W. C. Christensen, Wis., and S. R. S., U. S. D. A.)

machinery, and work with engines. Let the particular desires of the short-course students be learned, if possible, before the course begins. If some are anxious to install water systems for their home places, they should be taught the simple methods of pipe fitting, and should be allowed to make up a list of materials needed for their projects. If some students desire to do some terracing work on their home farms, they should be taught the methods of terracing while at the school. If others wish to build septic tanks and plan for the disposal of sewage, they may easily be given the instruction at school.

Assign Readings in Farm Mechanics.—An instructor should have in his mind or on library reference cards a number of useful topics which should be assigned as readings for individual students. Suppose a student is planning a project for the installation of a

water system or lighting system, or a sewage system for his home. Suitable references should be assigned so that he may read fully regarding the plans and suggestions given by one or more authors. Perhaps a bulletin will give him the very information which he needs

Fig. 99.—This class in farm shop work made feed hoppers, trestles, pig troughs, tool boxes, nail boxes, gates, handles, surveying poles, bag holders, and other articles. (J. A. Wisdom. Mo.)

before undertaking his project. The object should be to have the student feel that he really understands the difficulties that he is likely to meet and something of how to solve them before he goes into his work. He will feel that he is forearmed and will be able

Fig. 100.—Each boy in the club has made one or more bird houses. These boys will never destroy beneficial birds. (W. C. Brown, Mich.)

to exercise better judgment when unforeseen difficulties arise. He has the experience of some one else as well as that of his instructor to guide him. Or if the instructor is absent, the information which he has gathered from reading will be his main guide.

Discoveries in Farm Shop Work.—When students are operating or repairing farm machinery they should learn to discover causes and effects of certain results which they observe. For example, in

operating a sulky-disk plow there are certain adjustments necessary to make the disks do their best work. When certain difficulties are seen, try to discover the causes of these. In operating a binder, if an apron stops, the operator should discover the cause and remedy it if possible. In filling a silo, if the blower pipe fills instead of delivering the silage properly, some condition must be discovered which causes the trouble.

Many similar discoveries are necessary in the operation of farm engines, in the problems of drainage, in troubles with sewage and water systems, etc.

Mechanical Discussions.[2]—Lead students to form habits of discussing with the instructor the details of mechanical projects

FIG. 101.—Students of the upper grades as well as high-school students may easily learn to make concrete posts, and an incinerator for the school.

which they are pursuing. Even if these projects are minor ones they will furnish many important points which should be brought up before the class for consideration. The habit of taking notes should be well established. This will avoid forgetting the points which are to be discussed in the class.

Mechanical Observations.—How many points there are to be observed in shop work and in outdoor mechanical work! Many of these observations should be made. Probably the best way to teach students to make the observations is to quiz them on points which they are likely to overlook in their work. When a student has been quizzed and found unobserving, he may be aroused to better observation in the future. In surveying or running levels

[2] See topics for debate, Chapter XI.

the student may be led to form approximate ideas in differences of level, measures of angles, distances, or grades.

In road work he may be taught that he should observe what

FIG. 102.

FIG. 103.

FIG. 102.—This Alabama class laid over 300 square feet of concrete flooring in the basement of the school building for practice. Three of them earned money during their spare hours at such work for neighbors. (H. A. Savage.)

FIG. 103.—Students have practice in grading lawns and in building walks for the school. (Newport School, Tenn.)

curves are necessary, what angles may be avoided, what cutting or filling will be required before the road implements are actually used.

FIG. 104.—Students should learn the value of second-hand lumber. Left, pulling out nails. Right, lumber ready to erect a shop. (G. R. Ransom, Okla.)

Mechanical Drills for Skill.—Students performing certain shop exercises may be found to be very awkward or bunglesome and perhaps unsuccessful in their work. In such cases they should be given other exercises which will develop them in those particulars in which they are having trouble. This repetition of work may be given to the student in such a way as not to make him feel that

he is being drilled for the sake of skill (Figs. 102 and 103). There may be some other apparent motive in the second or third assignment. For example, if a student has trouble in tapping threads in drill holes and cuts them too deep or too shallow, it will be easy to let him try again on some other part of the repair of a machine. Never allow students to form bad habits of doing poor work in any department of mechanics. The quality of work should be judged in comparison with similar work by good mechanics. Another example is in the sawing of rafters when poor joints are formed by

FIG. 105.—Students studying the belting system, diameters of pulleys, speeds of engine and machine, and other points on a nearby farm. (Fairbanks-Morse Co.)

careless students. If the student cannot hold his miter-square accurately or cannot saw to a mark, he should be given drill enough in such work as the building proceeds to make him skilful in these matters. Students should be taught skill in handling and using old lumber (Fig. 104).

In splicing ropes (Fig. 86), if the results are not smooth and even, the students may be given other problems with other sizes of rope that will involve more attention to snug twisting and careful laying of the parts of the rope.

Solving Mechanical Problems.—Earlier in this chapter several problems have been suggested in figuring speeds of machines run by engines (Fig. 105). Problems in figuring the amount of

paint required for covering a building for first or second coats may be given. Students should be required to make lists of lum-

Fig. 106.

Fig. 107.

Fig. 108.

Figs. 106–108.—The erection of a school shop by students of a consolidated school. Fig. 106, mixing concrete for foundation; Fig. 107, framing; Fig. 108, building completed. (Lewiston, Minn.)

ber of different sizes and dimensions for specific building projects.

Many problems arise in connection with land drainage,

road construction, terracing, subdivision of lands into fields, and irrigation.

Reference Books and Bulletins.[3]—There are good books which should be in the library of schools offering courses in farm mechanics

Fig. 109.

Fig. 110.

Fig. 109.—The pig-cot and seed corn tree may be made by students as parts of their projects with pigs and seed corn. (D. M. Clements, Tenn.)

Fig. 110.—In his pig project this Wisconsin boy made the pig house of the piano box. (W. C. Christensen and S. R. S., U. S. D. A.)

and engineering. Have special books on farm motors; books relating to lighting systems; others on water systems; and others on sanitation and drainage; books on farm structures, some of which give plans of all kinds of buildings; books on concrete work;

Fig. 111.—Useful articles for the farm made by the students in the school shop. (A. M. Field, Minn.)

special works on drainage, irrigation, road construction, land surveying, and other special lines.

It is to such special works of reference that the instructor will send students who are looking up readings on their home projects. Instructors fully realize the value of such specialized books of reference. No textbook can possibly fill the need of students

[3] See also Chapter XVII.

requiring full information on problems and projects which they are undertaking.

Bulletins issued by the federal government, by state experiment stations, and by private companies are usually supplied freely to schools requesting them. Cement companies issue valuable bulletins on the uses of cement. Details of barn plans are found in bulletins furnished by companies selling barn equipment. Such pamphlets should be accumulated by the school and kept on the reference shelves for constant use.

Mechanical journals are published periodically, and a few of these may be on the reading tables of colleges, normal schools, and perhaps high schools offering work in this subject.

Engineering journals, electrical magazines, scientific and popular papers of a mechanical nature are worthy of consideration for this purpose.

EXERCISES

1. Plan a good, inexpensive shop building for the teaching of farm shop work (Figs. 106–108).
2. Make a list of material for the construction of this building, with prices.
3. Form an estimate of the number of days it would require for ten students to erect this building, and decide whether, or not, you would advise them to undertake it.
4. Make a list of tools and equipment you would place in such a building, with price of each.
5. Outline fully an extended project in mechanics connected with poultry work.
6. The same for a project connected with dairy work.
7. The same for a project connected with sheep and beef-cattle work.
8. The same for a project connected with sheep and swine growing (Figs. 109, 110, and 111).
9. The same for a project connected with farm improvement.
10. Conduct a community survey regarding farm buildings and equipment in a small neighborhood.
11. Another on modern farm machinery.
12. Another on tile draining and terracing, or the need for either of these.
13. Conduct a trip with fellow-students, or others, for a farm mechanics study at a good place in the neighborhood (Fig. 96).

QUESTIONS

1. Give a comprehensive outline of the fields to be covered by a course in farm mechanics and engineering.
2. Give suggestions for special methods in teaching this course.
3. What equipment would you want for teaching farm power work?
4. Why should the class work in farm mechanics consist chiefly of laboratory work?
5. How would you plan to base the class work on the laboratory work?
6. Why would you base the laboratory work and home project work, in this field, on the other agricultural projects of the students?
7. Illustrate how you would do this in each of the kinds of agricultural projects.

8. Suggest a number of exercises with farm power.
9. Give reasons why community survey in farm mechanics are helpful.
10. Give a list of topics for such a survey.
11. How could you use a set of lantern slides to advantage in teaching farm mechanics?
12. What benefit is derived from students drawing plans for farm buildings?
13. Why is the study of physics helpful in a course in farm mechanics?
14. Give a list of suitable trips which you might make with your class in this course?
15. How could school shop work be of aid to the community?
16. Give suggestions for teaching shop work in rural schools.
17. In what fields should a teacher of agriculture be proficient to teach farm mechanics successfully?
18. Suggest a list of exercises for shop work in town grades.
19. What would be suitable lines of farm mechanics for short-course students?
20. Suggest reading assignments in farm mechanics.
21. Suggest several subjects for debate in this field.
22. What observations can you suggest that students should make in this field?
23. What lines require considerable drill to secure the proper skill in shop work?
24. Make a list of mechanical problems to be solved by students.
25. What reference books would you include, in this field, in a high school library?

REFERENCES

Farm drainage, Minn. Ext. Bul. 13; Rope work, Minn. Ext. Bul. 33; and Minn. Bul. 136 (15 cents); Cornell reading course, Bul., Vol. 1, No. 8; Iowa Ext. Bul. 24.

CHAPTER XI

HOW TO TEACH FARM MANAGEMENT

"The specific aim of the work in Farm Management is to enable young people to obtain such a knowledge of sound principles and correct practices essential in the proper selection, organization, equipment, and operation of a farm as a business enterprise as will prepare them for financial success in farming."—Report of Committee on Agriculture of the N. E. A. Commission on Reorganization of Secondary Education.

THE purpose of this chapter is to aid teachers so to teach farm management as to accomplish most effectively the above aims. Chapters V to X, and XII treat of the methods of teaching subject matter so that students may pursue farming operations with greater profit. Many features of farm management are therefore presented in those chapters. Persons using this book will find there many suggestions, in addition to those given in this chapter, that will be helpful in the teaching of farm management.

Content of Farm Management.—In the subject of farm management should be included the study of the types of farming, comparison between intensive and extensive methods, diversified and special methods. It must be concerned with the maintenance of soil fertility, livestock problems, suitability of farm operations to soil, climate, and market conditions. It must include a study of the relationship between size of farm, capital available, and projects undertaken. The questions of ownership, rental, employment of labor, securing equipment, arrangement and cost of buildings, and the planning of cropping systems are all included. The business of farming—farm records and accounts and the selling of products—is an important department of farm management. How to secure good roads over which to travel and market farm products is vitally connected with farm management (Fig. 112).

Special Methods in Farm Management.—While methods of conducting the class meeting do not differ in farm management from the methods used in other subjects, attention should be called to a few features relating to the subject matter and its treatment which need special emphasis.

Farm management, dealing as it does with the proper combination of all of the farming operations considered in the preceding chapters, is more dependent than is any of them upon local data if its teachings are to function in the farming of the future. Agron-

omy may teach how to raise an abundant crop, but farm management may show that, regardless of abundance of yield, such a crop should not be grown in that locality. To know how to raise good crops and animals is necessary but not sufficient. To know how to make a profit from the entire complex of farming operations *under local conditions* is essential and is the cornerstone for the teaching of farm management.

The teacher must have available not only the data gathered by the office of Farm Management of the U. S. Department of Agriculture and by the state colleges of agriculture of such states as Minnesota and New York which may be used as general foundations, but should have the data gathered by his own state college of agriculture and by any other state institutions, such as normal schools. If the teacher has done the work of the preceding chapters, he will have the results of many surveys made by himself and his pupils which he has used as a part of the work of those chapters. In addition to the use made of them there they may be utilized with new values in the farm management studies. Besides these, additional local surveys supplementary thereto should be made by the farm management class.

Not only must students use a large amount of data much of which is local but they must know how to use it. This requires a clear knowledge of the fundamentals of bookkeeping and of the methods of using simple statistics. Unless the pupils have had this training previously it must be given in the farm management class.

There are a few good textbooks on farm management suitable for secondary schools, normal schools, and colleges which may be used as guides and references; but the teacher who permits his farm management work to degenerate into a mere study of books is not only losing his opportunity but is also cheating his pupils out of their birthright—a practical knowledge of how to manage successfully farm operations in that locality.

Class Work in Farm Management.—Let students prepare topics for class recitation which are broad and exhaustive rather than mere opinions or one-sided discussions of the different phases of farm management. For example, good topics at the beginning of the course are: (1) The farmer as a business man. (2) The farmer as a scientist. (3) The farmer as a mechanic. (4) The farm a place for efficiency. (5) What the farmer needs to know.

Early in the course let some student contrast the cost of living on a farm with the cost in a city. Let another study and report

on the profits in farming; another on the safety of investment in farm lands; another, the estates left by farmers to their children. Such topics will aid the young student in deciding more definitely that he will be a farmer.

Topics may be assigned that will aid students in determining the types of farming which they will prefer to follow. The instructor can, by careful thought, select such topics in farm management as will help the student to be a better farm manager. He should strive to make the topics suit the conditions of the young

FIG. 112.—The condition of the roads greatly affects the number of visits by the instructor to home projects. There are too many roads like the one shown here. (C. D. Clements.)

students in his class. Let abstract principles be omitted unless applications of them can be found by which to make them real to the students' minds. Whenever topics including principles in farm management are assigned, the student should be required to find an example in the neighborhood or elsewhere in his observation or experience which will illustrate or impress the principles learned. These examples should be given in class recitations so that all members of the class will realize their bearing upon real life and actual farming.

For example, in the study of intensive and extensive farming examples of both should be constantly before the minds of the students. In the study of ways of farming with small capital

apply the study to the lives of the students in the class. Let each tell how certain young people have started into farming for themselves. Let them plan different ways by which members of the present class may themselves start into the business of farming. In the study of the farm labor problem let students describe men who have worked on their farms, wages received, ideals and ambitions of these men, hours of labor, methods of managing the men, scheme used on their own farms for the efficient use of farm hands on stormy days, the ways of making farm laborers contented and making them interested in their work.

A good class exercise when the subject of horse labor is up would be for each member of the class to make a report of the number of days their horses work on their own farms in a year. Let them report on the cost of keeping horses when idle. Let the most efficient cases and the most wasteful cases be contrasted with each other when reports are made.

When the relation of farm equipment to type of farming and size of farm are under consideration, let each student make a list of the machinery equipment on his home place, with the value of the same. These lists may be contrasted in class and will form a basis for practical discussion. Let the lengths of life of the machines of each kind be compared, and find causes for difference.

Make many problems for students to solve, and report the results in class. Base these problems on the experience of the members of the class. Make problems on factors that affect farm profits; on farm improvements; on waste in farming; on soil management; on farm planning, and many other phases of the subject.

Laboratory Work in Farm Management.—Let students make plans of farmsteads showing the arrangement of buildings, wells, roads, walks, and fence lines. Distances should be shown, or the drawings may be made to appropriate scales. Let the students draw their own farmsteads first; later others may be drawn, as those of neighbors. After these are drawn as they really exist, the student should study the rearrangement, and after planning he should redraw the same farmsteads showing better arrangements, with the least possible cost for the changes suggested. Let each strive to make plans that will save steps in the daily work of the farm. Let the elements of risk from fire be also taken into consideration.

Let students draw plans showing the actual size and location of the fences and fields of their own farms and perhaps those on neighboring farms (Fig. 113). The crops grown and the rotations

practiced on these farms should be indicated on the drawings. Study the arrangement of fields with reference to the location of the barns and residences. Consider the distances for going to and from fields with crops, manure, and for the annual field labor. Consider the shapes of fields and calculate the cost of plowing fields of different shapes. After sufficient study is given to the farm as it is, let it be replanned and redrawn to remove as many of the

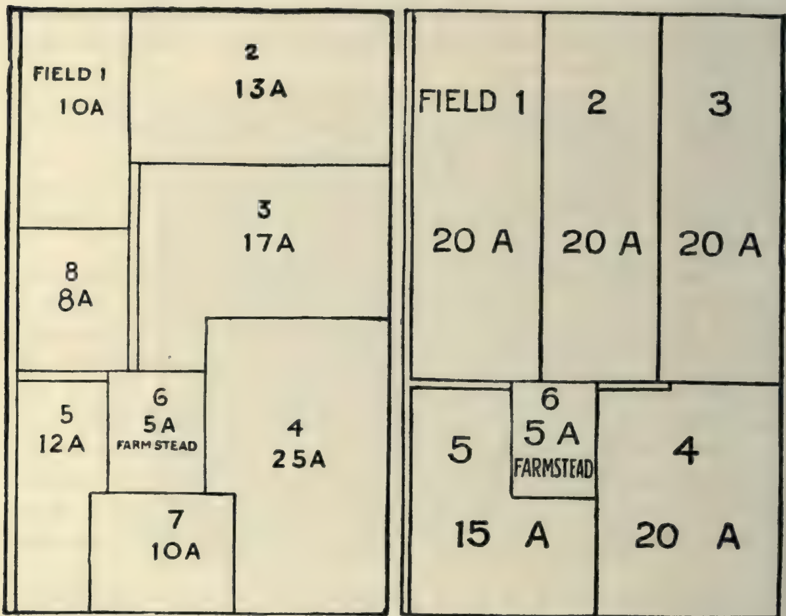

FIG. 113.—How students make plans of their own farms or the farms of neighbors. (Cromwell's "Agriculture and Life.")

losses as possible. Let the shapes of the fields and the location of the fields be changed to agree with the best teachings of farm management (Fig. 113).

Try laboratory experiments to prove the efficiency of paint in preventing rust, corrosion, and rotting of various metal and wood surfaces. Try laboratory experiments to demonstrate the importance of using green manure in the maintenance of soil fertility. Other experiments to demonstrate the losses from leaching, from erosion, from burning of organic matter, from bad management of the farm manure crop, from wasting wood ashes, from misuse of commercial fertilizer, and other bad management regarding soils.

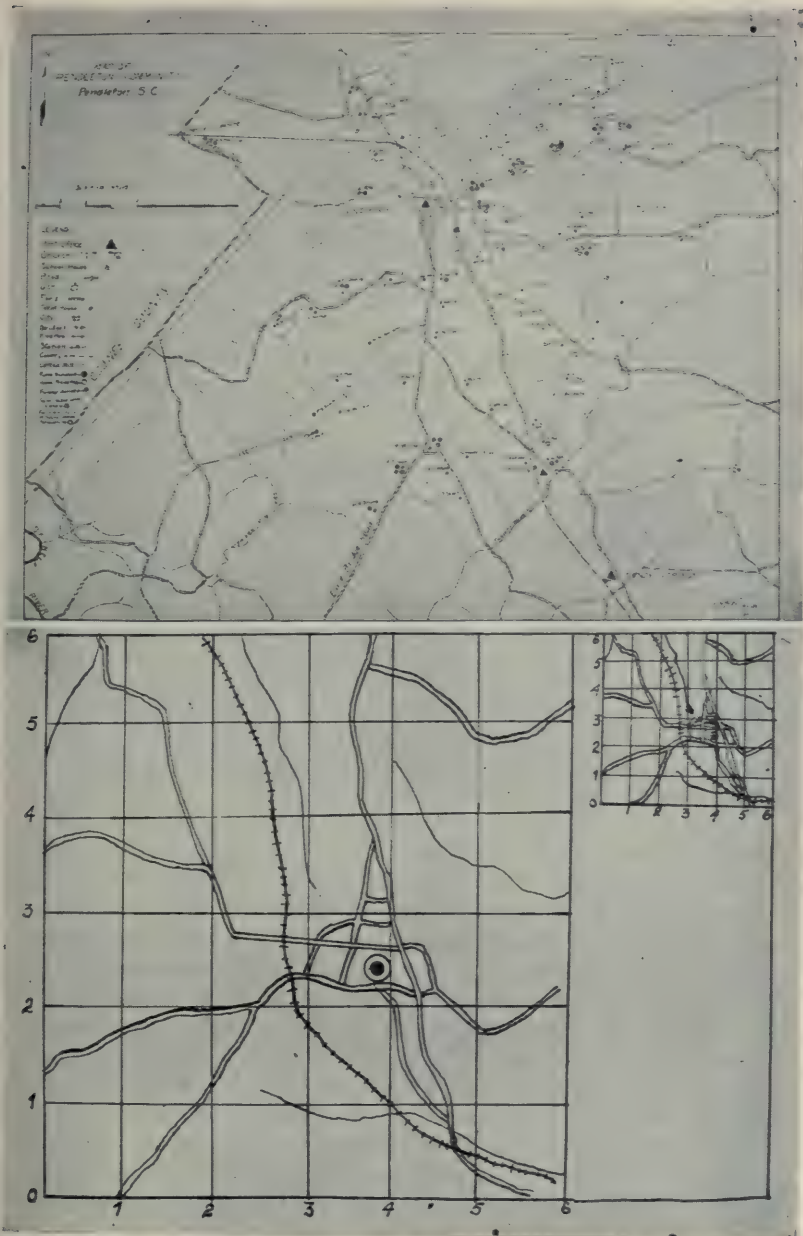

FIG. 114.—Make a community map, enlarged from a county map or R. F. D. map, by the process of drawing squares shown in the lower part of this figure. Locate houses, schools, churches, roads, places visited by class, pupils' houses, points of agricultural interest, and streams. (Albert Barnett, S. C.)

Plan laboratory exercises in the use of business forms, including notes, checks, receipts, contracts, mortgages, insurance papers, leases and deeds. Have exercises in the use of card indexing of addresses for use in selling pure-bred stock by mail.

Have students practice the making of applications for registration of pure-bred stock of all kinds. Let all students have practice in keeping records of litters of pure-bred swine, records of pure-bred cattle and sheep. Let them become familiar by actual practice with the records and blanks required for use in registry of merit work. Let students have practice in keeping milk records and calculating incomes when weights and butter-fat tests are known. They should make graphs showing the production requirements for profit of members of a dairy herd. Let the production of each member of the herd be shown in graphic form. The production of each animal should be compared by them with the minimum profit line.

Have students learn to keep egg records, incubator records, brooder records, and other poultry records.

The laboratory work should give students practice in cost accounting which should be based upon the actual farming on the students' home farm. If students are pursuing projects in crop production and animal production for profit, they should make these projects the basis of their laboratory practice in bookkeeping. Their fathers' projects with various crops and herds may also be used. Let the simplest methods in record keeping be taught and practiced by students.

Let each student get a copy of the land description from the deed of his home place. This can be obtained at the recorder's office in the county seat, or the deed may be found at home and that portion copied for use in the laboratory. Let the student make a drawing of the boundaries of the farm from this land description. In those states or regions where farms are described by the system known as "meets and bounds" this exercise is often a difficult one and should be given careful attention. In states where the land descriptions are made according to the Congressional system, the students should learn to describe their own farms by this system. A map showing the principal meridians and the ranges or base for the region should be secured by the school for use of the students (Fig. 114).

Special forms and systems to be studied by students in the farm laboratory should be selected by the instructor according

to the special industries of the region. Some of these may be: Keeping records of pickers in berry patches, keeping records of men in gathering truck crops or field crops, keeping time-books and pay-rolls on large plantations, keeping records of the work of packers of fruit, the packers of eggs, the picking and dressing of broilers.

Field Exercises in Farm Management.—It has already been suggested that the farming methods found in the region be analyzed as a basis for the studies in farm management. In the fall, when the farmers are harvesting and storing crops, let the class go to a fruit farm, for example, and study the management of labor, the methods of transporting products to market, the prices received,

Courtesy Planet Jr. Company.

Fig. 115.—Students should visit farms heavily equipped with machines and work-horses and study the relation between the capital invested in them and the total capital and income. Also make a graph of the horse labor distributed by months. (Productive Farm Crops.)

and find in what ways any of these methods could be improved. Perhaps several farms of the same character can be studied and comparison made by members of the class. At each place inquiry can be made regarding the different items which make up the cost of production. The probable profits from each enterprise can thus be approximated.

Students should visit large plantations (Fig. 115) or smaller farms that are supposed to be operated according to the best business methods. Let them find the best points and the weak ones in the management (Figs. 116 and 117). These should be compared with other farming methods of the region. Different types of farming should be included, if possible, in the visits of the class.

If there is a marketing association of any kind in the region, students should make a detailed study of the work of the business manager, learn the duties and responsibilities of members, deter-

FIG. 116.—Tractor *vs.* six horses. One stall instead of six; tractor does not eat when not working; no harness to buy; no horse chores to do. The twenty-five or thirty acres required to feed six horses will feed as many dairy cows, producing human food. At this student's farm the horse is gone. (Cleveland Tractor Co.)

FIG. 117.—Students must be taught to solve the problem of what kind of work animals are best suited to the farm. Cattle are still useful for this purpose on many farms that are stumpy, hilly, or rocky; and where grass is abundant they are maintained economically.

mine the advantages of the association, and discover, if possible, any dangers which are likely to arise by marketing or selling fruit to such an association. Learn how buyers are secured and contrast the prices received by this method and other methods of selling.

Excursions should be taken to nearby market places to study different methods of preparing products for market, to study the details of selling to commission men, selling direct to consumers, and selling to wholesale dealers.

In regions where warehouses or elevators are used by farmers or by buyers, the class should visit them and study the methods of storage, the methods of receiving, weighing, price-fixing, and other details. In tobacco regions where there are loose-leaf floors or storage warehouses, the student should visit them on market days to learn many details of the business.

In creamery regions let the details of the business of operation of private or coöperative concerns be studied minutely.

The management of poultry packing plants should be studied by visits to these places. If there are important stock yards within reach, trips should be taken to them on the best market days and details of management should be studied and noted by every student. Let them follow one bunch of cattle or a lot of hogs and sheep from the car through the yards during the weighing and buying by the dealers, through the regrading and sorting of the animals, through the reselling and distribution of these. Prices, commissions, weighing fees, dockages, etc., should all be learned by all the class.

It will pay for the class to visit a packing house where livestock are slaughtered and dressed. They should learn the methods of inspection by federal authorities. They should learn the different cuts of meats produced by this packing plant. Find what criticisms the owners or managers may have regarding the classes of animals which they are compelled to use.

Management of Other Farm Details.—On various farms and on suitable occasions the students should learn the management of labor of men and teams, economy in making the best use of important farm machinery, care of farm machinery. They may study other important details in the chief farming operations, such as threshing the grain crop, filling of silos, husking and shredding the corn crop, harvesting and curing a tobacco crop, picking and packing an apple crop or peach crop, constructing roads or important farm buildings, and any other important farm operations which may be found.

Farm Management Surveys.—Early in the course, or before it begins, special farm management surveys may be made. Let one special line of farming be taken at a time. The questions should

be so worded as not to offend the farmers who are asked to answer them. Each survey should be as brief as is consistent with good results.

If the surveys regarding each line of farming have been made in connection with the study of that branch earlier in the course, perhaps the answers can be studied by the class and the management features gleaned from them. After going over the early surveys on the special subjects, it may be found that a few additional points of information should be gathered. In that case perhaps the students will be able to answer the questions themselves without consulting the farmers of the region. Let the additional questions be made and answered either by the students or by the farmers.[1]

Take the subject of dairying, for example; the special dairy survey suggested in another chapter will bring out many of the methods in management. It may be desirable to ask each dairyman of the region regarding the prices received for products in various months of the year. The methods of marketing products may be asked. The kinds of accounts kept by each dairyman may be included in the dairy management survey. Questions could be asked regarding their attitude toward coöperative marketing, toward price fixing, toward coöperative buying of feeds, and other points which the instructor may wish to include because of certain local conditions.

Charts on Farm Management.[2]—A number of valuable charts can be made from illustrations in bulletins and reference books on this subject. Valuable suggestions for farm management charts are often found in periodicals. Perhaps some of these may need to be modified to suit local conditions. Let the results of local surveys be formulated into charts without being personal.

Farm management charts should be useful in class work and in community work in the region. Some of the drawings of farmsteads or of farm fields, with the replanning of these, may be made into large charts for use in these ways (Fig. 113). Forms to be used in record keeping may be placed on large charts.

Lantern Slides on Farm Management.[2]—A number of photographs may be taken by the instructor or members of the class on their field trips. These may be made into lantern slides and used from time to time in class work or in community work. Other lantern slides which relate to the general subject of farm manage-

[1] See suggestions for farm surveys, Chapters V to X, and XII.
[2] See also Chapter XVI.

ment may be secured from supply houses. The subject is so broad that it is sometimes difficult to select a good series of lantern slides best for any special meeting where the topic is to be discussed. It is far easier to arrange the slides according to the management of any particular line of farming. Sometimes it may be desirable to select a few slides on each of the types of farming.

Many sets of slides may be borrowed. A number of slides touching upon various phases of farm management may be easily chosen for illustrating special points in this subject.

Farm Management in Rural Schools.—Much of what has already been said regarding how to teach farm management will apply as well to rural schools as to other schools. It is not believed, however, that this subject should be taught as a distinct subject in rural schools. Many of the points in the best management of farms should be taught by studying particular cases in the district. These should be taken up in connection with the study of the subjects themselves. Management of the poultry business should be considered in connection with the study of poultry husbandry. This should usually be the case with each of the other branches studied in the rural school.

Teaching Farm Management in Town Grades.—Perhaps some few points regarding simple principles in farm management can be studied in grade schools below high school rank. If such lessons are attempted they should be of the concrete form and deal chiefly with materials. In the upper grades some of the laboratory exercises suggested in this chapter may be used. Business forms, drawings of farmsteads and perhaps the drawing of farms with fields are exercises not too difficult for students of the upper grades. Trips to elevators, packing houses, warehouses, and other places where farm produce is handled will bring to the minds of town children many elements in farm management which will broaden their minds and cause them to think of the importance of good farm management.

Farm Management in Short Courses.—When high schools offer short courses for only a week or a few weeks they should not attempt to teach the whole subject of farm management in its many phases. They should select the elements in farm management which relate to the leading kinds of farming of the region. These elements of farm management should be impressed on the farmers or students attending such brief courses. Most of these lessons should be given to the students by successful farmers who

are known to have been successful in the special lines of farming under consideration. These farmers should speak from experience and tell of their own management. The lessons in farm management which are to be impressed during any short course should be few in number and important enough so that they will bear repeating many times during the course. This may be planned by the program committee or the instructor of the school so that all of the students will feel that they have learned well the methods in farm management.

In college short courses the problem is only slightly different from that just discussed. More lessons may be considered when the course covers several months. As the farmers or students attending college short courses are producers, it is best to have the lessons in farm management deal directly with production and marketing of particular farm products. Frequently the students are following special lines of farming and the special management which is best for each of these special lines should be presented by specialists in those lines. Here also the instructor should speak from experience. Many of the field trips suggested earlier in this chapter may be taken by college short-course students. Much laboratory work may be planned for college short-course students if time will permit. If the time is too limited, only the most important lines of such work should be included.

A Typical Lesson in Farm Management.—Suppose that this is a second lesson on the subject of farm equipment. In the assignment of the lesson let each student be told to determine at home what machines are most likely to be purchased next on their farms. They are each to make a list of the needs for such a machine as they are about to purchase. Each is to determine the cost of the machine. Each is to outline the conditions which make it advisable to have the machine. He is to describe how the farm has been getting along without it. He is to calculate the saving in hand labor or in any other line by the purchasing of this machine. He is to show how much more produce may be raised on the farm by the purchase of the machine. He is to summarize all of this and prove to the class that it will actually pay to own this extra machine on the home farm.

At recitation time let each student report on the results of his study. Where mistakes in calculation have been made they should be pointed out and corrected. Be sure that each student has completely mastered the idea that the purchase of added equip-

ment for the farm should always be preceded by such calculations as these. Ask each student to tell of examples of the purchase of machines which have proven of little value on their farms or neighboring farms.

Let some of the best calculations made by members of the class be placed on the blackboard for class analysis and study. Be sure that the student has considered interest, depreciation, repairs, oil, and cost of operation when he is proving the value of the new machine.

Have each of the students take down some of the best calculations for each of the types of machines reported upon at these exercises. If time will permit, other problems along this line may be assigned to students for solution. If the recitation period is too brief for the complete study of all of the reports of members of the class, let the papers prepared by members be passed to others for review and criticisms. This step might be made in the first part of the recitation period, and after each critic has reviewed the paper of the fellow-student, then let the criticisms be brought out in class discussion.

Farm Management Discussions.—Teachers of farm management, assisted by their classes, should constantly watch for topics which are suitable for debates and discussions. The purpose of such debates and discussions is to keep the minds of students and producers active along farm management lines.

Teachers of agriculture should try to have their students discuss many farm management topics. There are many points which will be impressed upon their minds only by constant repetition and discussion. The time in class recitation is far too brief for all of the important principles in farm management to be thoroughly fixed in their minds. Indeed, if too many of the topics are considered, none of them will be as well fixed as they should be. Train students to discuss farm management topics among each other, to consult their parents frequently on many of the points. If they can interest their parents in topics of economy, farm losses, farm improvements, better livestock, etc., they will have accomplished much toward fixing in their own minds many lessons in farm management.

Debates on Farm Management Topics.—Suitable subjects for debate, either at community clubs, boys and girls' clubs, or in classes in agriculture, or at literary societies, are quite numerous. The topics, if possible, should be selected to suit local conditions.

The statement of the question may be positive or negative to suit the rules of debate or to suit the local conditions. The topics here suggested are easily modified and the list is not to be considered complete.

1. Resolved, that it is better for a young man to borrow money to start farming for himself than to work for wages until he has enough capital for the purpose.
2. Resolved, that the farms of this region have too much machinery equipment (or too little).
3. Resolved, that the school, church, and social conditions are more important in choosing a farm than the soil and topography.
4. Resolved, that the buildings of a farmstead should be assembled close together regardless of danger of fire spreading from one to another.
5. Resolved, that it pays better to rent farms than to buy them.
6. Resolved, that cover crops are better than terraces in farm management to prevent soil erosion.
7. Resolved, that it is better to raise pure-bred hogs (or cattle) than to merely own a pure-bred sire and grade up the herd.
8. Resolved, that farm laborers should be given better treatment and more opportunities to improve themselves instead of better pay.
9. Resolved, that it pays to paint farm buildings, plant shrubbery, vines and trees in the yards as much as to raise crops.
10. Resolved, that farm bookkeeping pays more for the time used than any other part of farming.
11. Resolved, that there are more kinds of loss in farming than in any one line of city business.
12. Resolved, that a majority of all farm losses are preventable.
13. Resolved, that the coöperative ownership of machinery is not profitable.
14. Resolved, that a coöperative creamery should be organized in this region.
15. Resolved, that the coöperative selling of livestock is better than selling through local buyers.

Things to Discover in Farm Management.—The student who thinks deeply into farm management problems will be able to make many discoveries. A number of lines along which discoveries must be made are suggested in the foregoing list of debatable questions. He must try to discover just what kind of soil management will bring the best results with the least effort and least expenditure of money. He must discover, if possible, whether the improvements of his farm in appearance, buildings, and farm equipment will really add to the value of his farm or to his income, or to both. He must discover whether advertising his product pays or not. He must discover what mediums of advertising are the best.

Let teachers of agriculture set students to work making discoveries in farm management. Have them report their discoveries in class from time to time. They may make some of these dis-

coveries while they are pursuing their home projects. Whenever a discovery is made by parents and neighbors it should also be reported by students at school. Let prospective teachers who are studying this subject increase the list or give about twenty-five or more discoveries that may be made.

Things to Solve in Farm Management.—Students should learn to solve many of the farm problems while pursuing home projects. A brief list of things to solve is given here merely for suggestion:

(1) How to secure better farm labor. (2) How to make labor better contented. (3) How to manage ignorant laborers with efficiency. (4) How to manage a berry or cherry crop without loss during wet weather. (5) How to train farm hands to put away tools and implements after using them. (6) How to best handle the farm manure crop with least loss. (7) How to teach dairymen to treat animals kindly. (8) How to induce teamsters to get good results from their teams without hurting them. (9) How to prevent sore shoulders during plowing season. (10) What system of bookkeeping would best suit my farm? (11) Would it pay to equip my farm with a supply of hay caps for curing clover or alfalfa in shocks? (12) Which of my lines of farming are most profitable on my farm? (13) Would it pay to add sheep to my list of livestock? (14) Would it pay to buy a manure spreader for my farm? (15) Shall I purchase a manure carrier and track for my barn? (16) Would a tractor pay on a farm the size of mine? (Fig. 116.)

Let the prospective teacher of agriculture extend this list to twenty-five or more. Teachers of agriculture should assign many problems such as these to their students for solution.

Things to Observe in Farm Management.—Teach young farmers to observe many points in farm management, particularly on the best farms of the region. Let them report their observations in class from time to time so that they will constantly be on the alert to see them whenever opportunity offers. A suggestive list is given to show teachers and prospective teachers just what is meant.

1. When some farmer has improved his farm by making suitable plantings, or improving the lawn, or painting the buildings, or building walks and better fences, notice the effect upon his neighbors and report what is said in the neighborhood regarding it. Does it help to lead others to improve their own places? Would a general improvement along these lines be a real benefit to the community in keeping boys and girls contented with farm life? Would such a movement be of benefit to land owners when buyers visit the farms?

2. Observe the effect upon farm hands when some farmer improves the sleeping quarters or otherwise tries to make farm laborers more contented.

3. Observe the effects upon any farmer when he begins to systematically keep farm records. Observe the effect on a farmer when he purchases purebred livestock of any kind. Also note the effect upon his neighbors.

4. Observe the difference in success between farmers on farms of the same general type. Is the difference due to arrangement of buildings, keeping accounts, or what is the cause?

5. When buyers choose farms in your region note the kinds of farms purchased.

6. Observe whether a tractor purchased by a neighbor has proven a benefit or detriment to his success as a farmer (Fig. 116).

7. Observe the different methods of handling manure, treating fields in winter, housing livestock, pasturing hogs, cleaning fence rows, marketing farm produce, selecting seed corn, buying farm and home supplies.

Things to Do in Farm Management.—Have your students do something worth while in farm management from time to time as they pursue the work in home projects. Let them report at school things they do in farm management. These may be approved or disapproved by the instructor. They may, if so desired, report some of the things to the class for discussion. Let the following list be expanded and kept before the students, or at least in the mind of the instructor, so that students may be reminded from time to time of the things they ought to be doing at home:

1. When marketing methods are not entirely satisfactory change them and report the change in method (Fig. 118).

2. If you have been hauling manure out to a field in winter when the ground was frozen, change your methods when a thaw comes if the hauling would injure the field.

3. If you have been borrowing tools and machinery from neighbors and can secure capital enough to buy what you need, report the change in management.

4. Keep machinery better housed, better painted, and better oiled.

5. Start a good system of cost accounting including all the leading operations of the farm.

6. Keep a strict account of the farm inventory, with the value of all articles of equipment.

7. Improve the dairy by keeping records of the weight and test of milk produced by each animal.

8. Keep all pure-bred livestock properly registered.

9. Make improvements if possible in the shape and arrangement of the fields of the farm (Fig. 113).

10. Plan better rotations for your farm if possible.

11. Stop all losses that you can find occurring on your farm.

12. Increase the amount of running capital for your farm operations up to the point of greatest profit.

13. Measure your farm by the labor income method and increase this to the highest possible point.

Farm Management Readings.—There are often accounts given in agricultural journals of successes in farm management. Students should be trained to read these with proper interpretations. There may be danger of overstatements or wrong impressions given by glowing accounts. Students should remember in reading these that many farm operations look better on paper than they do on the farm itself. If students would write up some of the operations that show good examples of farm management in the neighbor-

hood, they would see how these look when printed in the local press. Note the effect of these upon other students or neighbors who read them.

Many bulletins are issued by the United States Bureau of Farm Management and by similar departments in state colleges from time to time. These should be read and studied either for class use or for reporting in literary societies, community meetings, or clubs. Train students to read much on the subject of farm management. Their minds will thus be kept upon the subject more than if they gained all of their management lessons from class discussions without doing much reading. By reading students will be able to learn principles and to summarize results better than if they hear discussions only.


FIG. 118.—This New Jersey student established a "vocational" market at his home near the public road for the motoring public. (A. W. Hand.)

Teachers should assign readings to different students and have these students report at some specific time the results of their reading. Interesting stories in farm management have been published. Induce students to read these for mere entertainment and the results will be helpful in the management of their farms.

School Library Reference Books in Farm Management.[3] —Teachers should obtain the latest list of books on this subject from the States Relations Service, United States Department of Agriculture. Secure from this list all of the best and latest books on the subject. A few books on rural economics and agricultural economics should be included.

If the typical method of conducting the class work is to be followed for all or a part of the time during this course, there should be several copies of some of the best reference books on the shelves. This will enable the instructor to assign a number of students to the same authority in the preparation of topics for the same recitation. Books of a popular nature which touch upon farm manage-

[3] See Chapter XVII.

ment should be included in the list if there are funds sufficient to warrant this investment. They will aid in causing students to give more attention to the subject of farm management without realizing that they are really studying at all. Suggestions for the arrangement of library books are given elsewhere.[4]

Bulletins on Farm Management.[4]—From the same source above suggested get the latest list of bulletins relating to farm management. Obtain all of these that are still available and classify them for use in the school. Write to your own experiment station and to a number or all of those in other states and ask for a list of the available bulletins on this subject. Send for these bulletins and include all that in any way relate to better management on any of the lines of farming. There are many such bulletins published. These should be carefully grouped according to the suggestions given in another chapter.

Farm Management in Journals.[4]—There are several periodicals published which are devoted chiefly to farm management. These of course should be placed on the reading tables. Also include those journals which have good departments of farm management. Some journals publish excellent accounts of farm management by good writers. These are not always grouped in departments called "Farm Management." They are nevertheless just as valuable for students to read. Some schools make it a practice to send the agricultural journal to the home of students on Friday night to be returned Monday morning. If this is done, it is a good plan to have each student ask his parents to express their opinions of some particular article in the journal. This may start some home discussion. It may assure the teacher that the magazines are being well used and it establishes a connecting link of thought between teacher and parents.

EXERCISES

1. Make plans of a farmstead with which you are very familiar, showing many of the details, such as arrangement of buildings, wells, lots, walks, roads, and fences.
2. Plan and replan the lay-out of fields on this farm to make them the most ideal.
3. Make a card index of the pure-bred stock of a neighborhood.
4. Make application for registration of pure-bred stock for at least one breed in each of the kinds of farm animals—sheep, cattle, horses, hogs.
5. Make a form for keeping egg records; another for incubator records.
6. Select, or make, a set of forms for use in cost accounting for at least three of the field crops of your state.

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[4] See Chapter XVII.

7. Conduct a field exercise with your classmates, or others, to make a study of the farm methods in some particular lines.

8. Make a study of the rules, methods, and management of a marketing association in your region or elsewhere.

9. Conduct a trip for the study of markets in a good market center.

10. Conduct a study of a nearby warehouse, creamery, packing plant, elevator, or other institution of your region.

11. Make a farm-management survey of a small neighborhood.

12. Make one or more charts to aid in teaching farm management.

13. Take local photographs to teach important points in farm management.

14. Make a full outline of several typical lessons in farm management.

15. Make inventories of one or more farms.

16. Compare annual inventories of one farm, made in successive years.

17. Get blanks from the agricultural college of your state and of neighboring states and from the U. S. Department of Agriculture showing different systems of farm accounting.

18. Make a graph of the weekly price of corn, hogs, or some other farm product.

QUESTIONS

1. State the specific aim in a course in farm management.
2. Give the content of such a course.
3. What are some of the special methods in teaching this subject?
4. Give good topics for beginning class work in farm management.
5. Suggest a number of laboratory exercises in farm management.
6. How should students learn to keep account of cost of production?
7. Why should students practice the making of applications for registering pure-bred stock?
8. Why should students learn to use forms for keeping records of production in poultry? In dairying?
9. Suggest a number of field exercises in farm management.
10. Give topics to be included in a farm management survey.
11. How could you use farm management charts in farmers' meetings?
12. Suggest some suitable views for lantern slides for use in farmers' meetings.
13. How could you teach farm management in rural schools? In town grades?
14. Suggest suitable topics for farm management in a short course.
15. Review a typical lesson in farm management.
16. Suggest a number of topics for debate in farm management.
17. What are some of the things for a student to discover in this field?
18. What are some of the things for him to solve?
19. What are some of the things to be observed in this field?
20. Mention a number of things to do in farm management.
21. Suggest some reading assignments for this course.
22. Make a list of good reference books for high-school libraries, relating to this course.

CHAPTER XII

HOW TO TEACH SOILS

"The specific aim of the work in soils is to enable young people to obtain such a knowledge of the most important principles of the formation, properties, and management of soils, applicable primarily to their own vicinity, as will prepare them for the successful production of maximum crops and the maintenance of soil fertility."—Report of Committee on Agriculture of the N. E. A. Commission on Reorganization of Secondary Education.

Field Covered.—This subject includes the origin and classification of soils; relation of composition to plants and animals; soils and plant relations; soil and crop production; soil water, drainage and irrigation; tilth and tillage; soil organisms in relation to fertility; chemical elements of fertility; liming in relation to fertility; the harmful agents in soils; crop rotation in relation to fertility; application of principles to soil management; soil erosion; systems of farming in relation to fertility; determining the needs of soils; profitable crop production; dry-land farming.

The content of the course on soils of any school should be made to suit the region. The soils of other localities need not be studied except in college courses and in teacher training courses.

The work given in the course on soils should be of a vocational character, *i.e.*, the theoretical and abstract phases of the work may be largely omitted in the teaching of vocational agriculture. For example, in those parts of the United States where irrigation is not practiced because it is not necessary, the study of irrigation systems and methods of handling irrigation water should be omitted. In regions where drainage is seldom or never needed, the problems of drainage should be omitted from the course of study. In level prairie states the problems of erosion should be omitted.

The study of soil formation may be considered prevocational in character. Such studies are better suited to elementary classes than to studies pursued in vocational agriculture.

The study of marsh-land farming, or the study of sands and their management, or the study of depleted clays and silts is chiefly of local importance and suited to special regions.

Relation of Soils to Other Subjects.—Much of the study of soils, so far as they are related to the production of horticultural crops, may be pursued in connection with the study of horticul-

ture. In the course in gardening make considerable study of garden soils and their management. In the course in fruit growing study fruit soils and their management. These subjects must contain such soil studies even if the students had a special course in soil work.

In the course in field crops some work in soil management must be given (Fig. 119). The general work in soil improvement

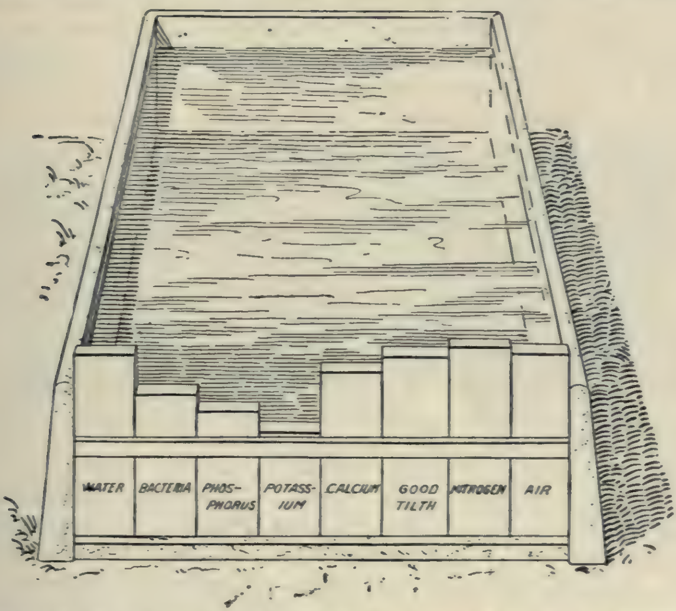

FIG. 119.—Teach students and farmers the importance of knowing the limiting factors in the soil's production. (W. W. Weir, "Productive Soils.")

and soil management is closely associated with field crop work. It is difficult to study the subject of field crops without considering much of the work in soils. Yet many schools find it advisable to offer a course in soils and fertilizers independent of the field crop work. In such cases it is probably best to let the course in soils be given at the same time as the course in field crops. In some schools, however, the course in soils is given after the course in field crops. In either case it is for the purpose of giving a more extended and thorough treatment of soils and fertilizers than is possible when combined with agronomy.

Equipment for the Course in Soil Work.—In making up a complete equipment for the soil laboratory, look over the list of apparatus in several of the soil laboratory manuals. The very full and complete lists in such manuals include many small items which need not be mentioned in this book. The laboratory should be well equipped with all items necessary. It should be remembered, however, that many items of expense may be omitted by substituting apparatus of a cheaper nature or equipment used in other courses in the school. For example, if a deep-cup milk testing machine is owned by the school, it may be used in experiments in the analyzing of soils. Deep soil test tubes may be obtained to fit the centrifugal machine and it will then serve two important purposes. Many experiments in capillarity, percolation, apparent specific gravity, and others may use such simple equipment as lamp chimneys, glasses (Fig. 120), empty tomato cans, cigar boxes, etc. If desired, a soil-packing machine may be omitted from the equipment by having the students pack the soil by dropping the container a given number of inches for a given number of times on a pamphlet serving as a pad.

Laboratory Apparatus.[1]—Besides the laboratory apparatus the school should have models of work tables, sinks, running water, cases and containers for illustrative material, supplies of many types of soil ingredients for experimental work. It is well to have cupboards with glass doors for the apparatus, cupboards with wooden doors for the supplies, drawers for glassware, test tubes and small apparatus upon shelves for the setting up of experiments which are to run for many days. The room should be arranged so that laboratory tables are convenient for use of the students, and so that seats may be provided in the same room for recitation purposes. Have cases with sliding frames for lantern slides. Have suitable shelves or upright cabinets for holding charts. There should be a drying oven, thermometers, a series of soil sieves, a few coarse sieves, soil auger, soil spade, drainage tools, glass tubing, test tubes, metal soil tubes, tall slender lamp chimneys, glass soil tubes, a compound microscope, several small hand lenses, reading glass and stand, a soil centrifugal machine or a simple substitute in the form of a Babcock tester with pockets big enough to hold the glass soil tubes.

Soil Supplies and Samples.—For experiments with soils provide good supplies of soils of various types from your region and other

[1] See also Chapter XV.

parts of the state. Be sure to include very sandy soil, heavy clay soil, medium loam, and soils very rich in humus. Have available also supplies of lime in several forms, such as rock dust, limekiln waste, air-slacked lime, hydrated lime, and freshly burned quicklime. The latter should be excluded from the air by placing it in a large can and having it securely covered. Prepare a set of small vials or tubes containing the proportionate parts of one or more soil analyses. Obtain also source materials for fertilizer mixtures.

Soil Containers.—Let the school be well supplied with soil bins or with covered galvanized iron cans holding several gallons. Small samples of soil from various farms may be kept in bottles with glass stoppers. These should be plainly labeled. Many of

Fig. 120.—Many tests with fertilizers may be made in glasses, tin cans, and flower pots. Here the trial is with different forms of lime in 1, 2, 3, and 4; compared with magnesia in 5. ("Agriculture and Life.")

the samples passed around for laboratory work or for examination in class may be in small vials, in paper trays, in Petri dishes, etc.

Flower pots and large experimental pots of galvanized iron may be used in trials and demonstrations in the growth of plants under various kinds of treatment.

Either in the laboratory or near by should be machines used in tillage of soils. These may be represented by good examples of machines of full size but of the smallest types. Others may be represented by models if these are obtainable.

Class Work with Soils.—If the course in soils has been well planned, the needs of the region will have been considered. The soil phases of project work of farmers and students should be included in the course. The best rotation for permanent maintenance of the fertility of the land will be given due consideration (Fig. 121).

The class work should be of such practical nature that students will feel the great value of each recitation and realize how closely

it is connected with their farm operations. Lesson assignments should be by topics and references to places in bulletins or books where these topics are discussed in the most practical manner. Abstruse and theoretical phases should be left to college courses and to courses where teachers of the subject are being trained. In assigning lessons, let students understand that they are to add their own experiences and observations to the reading which they do.

Let the class work also be based upon teaching of laboratory experiments. Never allow students to perform experiments in the laboratory without reporting their results orally in class recitations as well as in written form in their notebooks. If the experiments are of use, the application of them to farm practice should be made and the class recitation should bring forth all such applications.

Fig. 121.

Fig. 122.

Fig. 121.—This student ran a project in soil improvement. Here he has established a successful sod to turn under. The profit is determined by assessment of land before and after. (A. W. Hand, N. J.)

Fig. 122.—Students studying soils and testing for acidity in a cotton field. (G. R. Ransom, Okla.)

Let the mistakes of farmers and neighbors in soil management be brought out for topics of discussion in class recitations (Fig. 122). Also let the good practices in soil improvement and in permanently maintaining soil fertility and other good examples of soil management be clearly presented by students in class work.

A Type Lesson in Soils.—Suppose the lesson assigned at a preceding meeting of the class has been on the subject of liming of soils. The special topics of the assignment may be kinds of liming; forms most available and prices of these; effects of liming on sandy soils of the region; effects of liming on heavy soils of the

region; comparison of the effects of burnt lime and of crushed limestone; relation of liming to growth of legumes; relation of liming to upbuilding of depleted soils; connection between liming and manuring of soils; methods and times for applying lime.

Special bulletins on liming of soils may be used by students in preparing this lesson. Several of these topics are well treated in texts and reference books on soil physics and management. Students may be able to inquire in the neighborhood for examples which will illustrate points on these topics. The more inquiry they make during the study of the assignments the better it will be for them and for the community.

When the class recitation is presented, let the students assigned to the different topics be called upon. The examples which illustrate various topics should use a good part of the recitation period. As each case is presented and reviewed the instructor should develop by skilful questioning and by summaries the teachings which they illustrate.

Several phases of this recitation may be illustrated with classroom demonstrations. For example, the experiments in showing the flocculation of clay by the use of lime on clay soils may be performed in test tubes before the class while the recitation is in progress. All the different forms of lime usually used for agricultural purposes should be examined by each member of the class. The action of each upon litmus paper may be shown by students performing demonstrations before the class. The forms of lime that are found to be most practical for purchase in that region should be studied with greatest attention. Then the methods of applying, amounts per acre, cost of liming and labor, best times of year and best times in the rotation for its use should be stressed. One or two arithmetical problems may be placed upon the board to illustrate to the class the value of liming as a factor in soil improvement and crop production. Have the class learn by heart at recitation time the couplet:

> Lime and lime without manure
> Makes both farm and farmer poor.

Soil Laboratory Work.—There are a number of good laboratory manuals which may be used as guides in formulating the laboratory course in soil study. Some of these relate to soil physics and others to fertility. For students that are preparing themselves for vocational agriculture, both of these phases of the course should be

included. In other words, the course should be a composite one, including the physics of soils, fertility of soils, and the management of soils. In order to formulate the course special manuals or guides may be selected for use. Plan the course by hours, days, and weeks for the term. Select the exercises which the students are to perform in the laboratory. List these exercises and give references to manuals for each. Enough copies of these laboratory

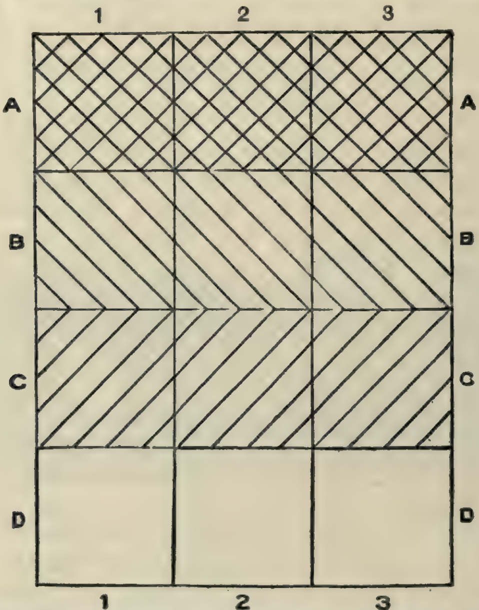

FIG. 123.—A scheme for experimental plots with trials of four east and west and three north and south. Suppose the experiment is with alfalfa 1–1, red clover 2–2, and crimson clover 3–3. Across these plots let the cross strip *A–A* be both limed and inoculated properly for each kind; let *B–B* have lime only; let *C–C* have inoculation only; let *D–D* have neither lime nor inoculation. Otherwise the plots will be treated alike.

manuals may be kept in the laboratory for use of the members of the class. The outline of the course may be either posted in the laboratory or a copy of it may be kept in the front of each student's laboratory notebook.

In most vocational courses in agriculture it is not absolutely necessary that all students perform all of the experiments. These need not always be performed in regular order. Much less equipment is needed if only a few students perform the same experiments at the same time. Some of the students may try percolation

experiments while others are testing the capillarity of different soils of their farms. Some may be working on lime while others are working with the effects of humus on soils. In the recitations which follow the laboratory exercises students must show that they are gaining by lessons from the laboratory work. Even though some of the students are not required to perform all of the exercises in the course, they will have gained much from the exercises performed by other students and by the recitation following them.

Certain students may be required to prepare composts for garden work. This may precede or accompany their projects in the growing of garden crops. Some students who are pursuing

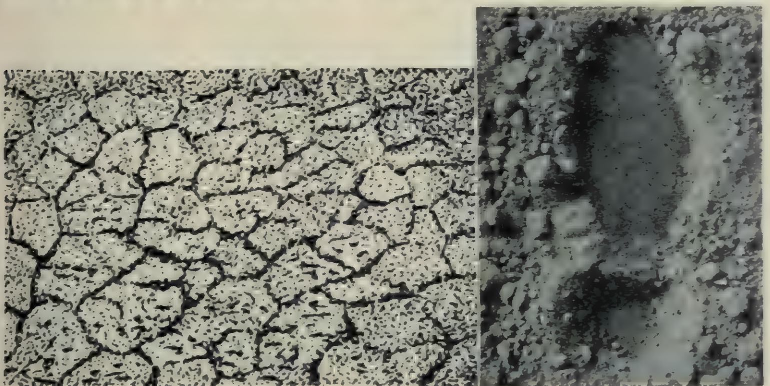

FIG. 124.—Teach students that soil with a baked crust cannot retain moisture, while a dust mulch will conserve it. Teach also the effect of foot pressure on loose soil. (Right, from Dunham Co., Berea, O.)

field crop projects may make special tests in metal cylinders to demonstrate the value of special fertilizers in the growth of those crops. If students have projects in the growth of legumes, they may demonstrate the need or lack of need for inoculation of soils by growing young plants of these crops in pots or cylinders. If it is desirable, these trials may be made more efficient by having the tests in plots outdoors. The mixing of fertilizers for special crops to be grown by students in their project work will be of value. Such exercises may be performed in the winter before it is time to start the field work.

In testing soils for acidity (Fig. 122), and in the study of the physical composition of soils, let each student use samples from his own home place if possible. He will then know more about his own soils and can act directly on the results of his laboratory trials.

Laboratory Exercises in Soils.—The following list of exercises is given for aid of teachers in formulating a suitable course in laboratory work. These are taken from five laboratory manuals to which reference is given. The manuals are:

(1) "Soils Laboratory Manual and Notebook" by Eastman and Davis (Lippincott); (2) "Soil Physics Laboratory Guide" by Stevenson and Schaub (Orange Judd); (3) "Soil Physics Laboratory Manual" by Mosier and Gustafson (Ginn); (4) "A Manual of Soil Physics" by Barker and Young (Ginn); (5) "Physical Properties of Soils" by Arthur G. McCall (Orange Judd).

These are referred to after each exercise by the number just given. The instructor should read over the list of exercises somewhat carefully and refer to them in the manuals before deciding which ones he wishes to include in the course in his own school.

Taking Soil Samples	1, 2, 3.
Studying Soil Grains	1, 4.
Composition of Soils	1.
Soil Classification	1, 4.
Volume Weight or Apparent Specific Gravity	1, 2, 3.
True Specific Gravity	1, 2, 3, 4.
Heavy and Light Soils	1.
Effects and Determination of Organic Matter	1, 2, 3, 4.
Effect of Lime and Other Chemicals on a Clay Soil	1, 2, 3, 4, 5.
Moisture Determination	1, 2, 3, 4, 5.
Capillary Rise of Water in Soils	1, 2, 3, 4, 5.
Effect of too Much Organic Matter on Rise of Water	1, 2, 3, 4, 5.
Percolation of Water Through Soils	1, 2, 3.
Clod Formation and Crusting	1, 2.
Effect of Soil Surface and Cultivation on Percolation and Temperature	1, 2, 3, 4.
Capacity of Loose and Compact Soil to Hold Water	1, 2, 3.
Effect of Evaporation on Soil Temperature	1, 2, 4.
Value of Mulches in the Retention of Moisture	1, 2, 3, 4, 5.
Optimum and Critical Moisture	1.
Drainage and Soil Temperature	1, 2, 4.
Effect of Color on Soil Temperature	1, 2, 3, 4.
Soil Ventilation	1, 5.
Absorption and Retention of Plant Food by Soils	1, 5.
Testing Soils for Acidity	1, 4.
Examination of Chemical Fertilizers	1.
Study of Plowing	1.
Examination and Discussion of Tillage Machinery	1.
The Effect of Alternate Wetting and Drying upon Granulation	2, 4.
The Effect of Alternate Freezing and Thawing upon Granulation	2, 4.
The Effect of Organic Matter on Granulation	1, 2, 4.
The Absorption of Gases by Soils	4.
Transference of Heat in Soils	4.
Specific Heat of Soils	3, 4, 5.
Determination of Pore Space in Soils	2, 5.
Effect of Rolling on Evaporation and Moisture	1, 2.
Mechanical Analysis of Soils	2, 3, 4, 5.

Studying Soils in the Field.—Classes may be taken to the fields of their homes or neighboring places. There they should learn such lessons as how to know whether or not soils need inoculation for special crops. They should study the needs of the fields with reference to drainage, terracing (Figs. 125 and 128), irrigation, prevention of erosion, addition of humus, prevention of heaving, etc.

They should learn also the value of special crops for soil improvement, winter covers, green manure, and prevention of wash-

FIG. 125.—Gullies have been stopped and graded over as home project work. (E. H. Thompson.)

ing. They can contrast good and bad ways of handling manure; the effects of special fertilizers; the influence of certain crops on percolation; the effect of certain treatment on alkali soils; suitability of certain crops to sandy soils, or marsh soils.

On such field trips students should consult with owners and study methods and management in detail. Learn how they could apply the lessons on their own places. They should always take notes of the lessons learned. They should discuss the lessons later in class meetings. They should be able to use the results of such field studies in the various assignments of class-room work and recitations.

FIG. 126.—Reclaiming the desert. Preparing raw land for a grain project, Florence, Arizona. (V. B. Anderson.)

FIG. 127.

FIG. 128.

FIG. 127.—Students of vocational agriculture running terraces with machine. (E. H. Thompson, Okla.)

FIG. 128.—Have students practice filling ditches with terrace machines. (E. H. Thompson, Okla.)

Judging Soil Conditions.—Not only the novice but often the experienced farmer has much difficulty in judging the condition

of the soil, as to whether it is fit to plow or not, fit to plant or not; whether the moisture is too much or too little, and whether certain treatments of the soil would be best.

Frequent exercises in judging soil conditions should be conducted by the instructor with his students. Some of the following questions will be suitable to use on different occasions or under different circumstances before the ground is plowed:

1. Is the soil warm enough for spring plowing?
2. Is the soil too dry for fall plowing?
3. What tests would be required to answer the two preceding questions?
4. To what depth can the soil be plowed without injuring the texture?
5. Would plowing under present conditions be best or should it have been plowed earlier or be plowed later? Why?

If ground is already plowed when the judging exercise is being conducted, the following questions should be answered:

6. How deep was the ground plowed?
7. Was the plowing too shallow or too deep?
8. Has ground been harrowed since plowing?
9. If not, should it have been harrowed? When?
10. Why should spring plowing always be harrowed immediately after plowing?
11. What effect would a plank drag have on the field if used at the time of your visit?
12. Would other conditions be better for this operation than now?
13. Effect of disking now or later?
14. Effect of use of spike-toothed harrow now or later?
15. What operations are best to put the field in good seed condition for small seed, as grass or clover?
16. For corn or cotton?
17. For potatoes?

If the judging exercise is being held while the crop is growing, the following questions should be answered:

18. What kind of tillage is now needed?
19. Has deep or shallow tillage been conducted preceding your visit?
20. In early spring would a roller or harrow on the grain field be most useful? Why?
21. Is the soil rather too sandy for hay crops?
22. Is the soil rather too heavy for potatoes or sweet potatoes?
23. What signs of good fertility do you find?
24. What signs of impoverished soil do you find?
25. What signs for need of liming do you find?
26. What signs of bad handling when too wet or too dry do you find?
27. What remedies would you suggest?
28. Do you think subsoiling would suit this field? Why?
29. What indications are there of lack of humus or abundance of humus?
30. Does the soil need draining?
31. Would irrigation be practical?

Students should ask themselves these questions frequently when in the field. Too much skill in the judging of soil conditions cannot be attained by even the very best farmers. Formulate

plans and operations which would suit conditions to be found at any and all times.

Soil Surveys.—Rather early in the term the instructor and students should plan to make a soil survey covering the territory as thoroughly as possible. This survey may be brief and need not require much time. If the questions are made at school and the blanks are taken home by pupils, they may be returned within a day or two. Some students will be able to obtain the data called for in the blanks from their own home places and from several neighbors, if time for this will permit. Topics which should be included in such a survey are here suggested: [2]

Name.
Size of farm.
Area devoted to each crop.
Soil sandy or heavy.
Acres damaged from erosion.
Acres underdrained or ditch drained.
Acres of winter cover crops.
How barnyard manure is kept.
Acres limed.
Crops on limed fields.
Kinds of fertilizer.
Is it considered profitable?
Location from school.
Leading crops grown.
Yield per acre for each.
What fruits are grown?
Acres terraced.
Acres under irrigation.
Acres of green manure plowed under.
When applied to fields.
Rate of application.
Acres of commercial fertilizer.
Crops grown with fertilizer.
Field rotation followed.

Lime Survey.—The object of this survey is to determine the practices of the farmers in any region regarding the use of lime in crop production. The following questions may be included on a lime survey card:

Name of farmer.
Location.
Renter or owner.
Kind of soil.
Number of years liming has been practiced.
For what crops.
Upland or lowland.
Usual rotation.
At what stage in the rotation is lime used?
At what stage in soil preparation?
Frequency of liming.
Amount of lime per acre.
Kind of lime.
First cost of lime. Cost of hauling. Freight.
Do you use your own crusher?
Community crusher.
Effects of liming noticed.
What increase in yields?
Do you test your soil with litmus paper?
Other indications of need of lime.
Have clovers failed for want of lime?

Charts for Soil Teaching.[3]—Many charts can be made by schools for use in teaching lessons in soil management. These charts will be useful in regular class work, in short courses, and

[2] See also suggestions for farm surveys in Chapter V.
[3] See also Chapter XVI.

in farmers' institutes. Suitable material for making these charts may be gleaned from experiment station bulletins and government publications. A few suggestions for charts are here given:

1. Make a chart on the losses from badly stored manure. Show the percentage of loss of nitrogen and other fertilizing ingredients due to leaching and heating. Represent these percentages in bar graphs of different lengths. The results from good methods may be contrasted with the results from poor methods.

2. Shocks of hay of different sizes may be used to show the effects of liming on the yields of clover, alfalfa, and other crops. This chart may give the cost of lime per acre and increase in yield due to liming. Thus the profit from liming may be shown.

3. Make a chart comparing the effects of yields from three different treatments of soil, viz., plowing under green manure, applying barnyard manure, using complete fertilizers. The quantity of nitrogen in these should be the same. Get the results from some bulletin reporting a trial already made. The yields may be shown in bar graphs, or in shocks of hay of proportionate sizes.

4. Make a chart showing the importance of supplying the fertility in the soil which is most needed. A barrel of water may be shown, the barrel having staves of different heights. Each of the staves may be labeled to represent a particular plant food of the soil. The shortest stave will limit the capacity of the barrel.

5. Make a chart showing the relative amounts of plant food removed from soil by all the various crops or products sold from the farm. The percentages may be represented by bar graphs of different lengths. (See Woll's "Productive Feeding of Farm Animals.")

6. Make another giving the benefits of home mixing of fertilizers.

7. The effects of humus on soils may be worked out into a good chart.

8. Make a chart comparing the methods of handling barnyard manure.

9. Winter cover crops may form the subject of a good chart.

10. Dust mulch and shallow cultivation may be combined in a single chart.

11. The benefits of drainage; methods of drainage; cost of drainage; soil aëration; soil moisture—each of these may be the subject of a special chart.

Lantern Slides for the Teaching of Soils.—Schools supplied with stereopticons should have a number of good lantern slides showing the effects of growth of crops by the use of lime, fertilizers, and good tillage. Contrast each of these, if possible, with other slides. If local pictures can be taken, the school can make its own lantern slides from the negatives. Take pictures showing the growth of green manure crops, operations in liming, good tillage implements on various farms while in use, and many other local views.

The Value of Physics and Chemistry in the Study of Soils.—Much of the work in studying soils is founded upon principles in physics or involves a knowledge of chemistry. It is, therefore, important to have students take these fundamental sciences as early as possible in their courses. If one or both of these sciences

can be pursued by students preceding or paralleling the course in soils, the students will gain much more from the soils course.

It is very important that students who are planning to teach the subject of soils should have a knowledge of both physics and chemistry. Many of the lessons in soils involve principles taught in physics, such as porosity, specific gravity, specific heat, evaporation, and capillarity. Chemical knowledge is required in the thorough understanding of problems of soil fertility and the relation of these to crop production.

Plot Trials for Teaching Soils.—Many lessons in soil management may be demonstrated on small plots in the garden or land laboratory of the school. Trials with small amounts of different varieties of garden and field crops may be made. The effects of fertilizers of different kinds and amounts and of lime may be shown on such plots. Soil management of various kinds may be contrasted, as the effects of rolling and not rolling, the effect of harrowing after rolling, the effect of subsoiling, and the effect of double plowing.

It is a good plan to have some of these trials run crosswise of others (Fig. 123). For example, when alfalfa is sown at three different times to show the effects of time of seeding, these three plots may be treated with cross plots run at right angles to the other. One of these cross plots has artificial inoculation; another is limed and inoculated; another is the check plot and another is limed only.

Soils Work in Rural Schools.—Many lessons on soils can be taught to students in rural schools. They are close to the soil and yet know little about it. Many of the lessons in soil physics should be taught. With simple apparatus such as lamp chimneys, tomato cans, and small boxes, glasses (Fig. 120), and other cheap apparatus many experiments may be tried in the school-room showing the different kinds of soil moisture, lessons in capillarity, percolation, effects of mulching, effects of packing and rolling, the bad effects of allowing soils to crust, the effects of color on soil temperature, and many others. Lessons can be made from trials in the community showing effects of certain treatments in improvement of soils and in maintenance of soil fertility. Students may be taught to run levels for simple work in terracing or contouring of fields.

Make all the soil studies pursued in rural schools as practical as possible. Base upon the experiences of students. Teach a few important lessons and stress these few lessons in many

ways by examples found on different farms. Suppose you wish to teach students to test soils for acidity, a few cents' worth of litmus paper is all the equipment needed. Students may be shown how to make the test, then each should be required to test one or more fields of his home place and report results. Build upon this trial with lessons on liming, the effects of liming, the possible improvement of soil as result of growing legume crops after liming. Then the effects of growing any crop desired because the land has been rejuvenated.

Teaching Soils in Town Grades.—The suggestions given under the heading of rural schools in this chapter should be read again in this connection. The more simple lessons and experiments can well be tried in the grades of villages and cities. Pupils should become familiar with different types of soil and study them by examining the particles and trying various experiments with them. Include sand, clay, silt, loam, dark humus soils, etc.

If the students of these grades are pursuing home projects in gardening, they will be much more interested in the soils work. This is a much better way of teaching lessons in soils, *i.e.*, in connection with projects of growing garden crops. Try to make all of the lessons in soils given to these children apply to some project which they have tried or are pursuing. They may be taught how to make a compost heap and use the lawn mowings and leaves raked from lawns to produce humus for their gardens. All details of soil treatment may be taught (Fig. 124).

Short Courses in Soils Work.—As a general thing, short courses in agriculture give very little special work on soil theories. Practical methods of improving soils (Fig. 125), the special uses of lime and other liming problems, the use of fertilizers for special crops, other special treatments of soils for various crops, soil inoculation for legumes, the care and best use of barnyard manure, the protection and use of green manure—these and similar topics may well be offered in short courses in regions where they would do the most good.

Use charts, lantern slides, soil samples, lime samples, fertilizer samples, specimens of crops suitable for growth for green manuring. Field trips should be freely employed for the teaching of practical short course lessons. Students may be taken out in the field for exercises in terracing and drainage. Places should be found where the short-course students can witness the steps in the rejuvenation of depleted soils.

Let classes also witness the use of special forms of plows, subsurface packers, tractor attachments, and other machinery used in the tillage of soils (Fig. 126).

Things to Discover in Soils Work.—A few of the many things that students should try to discover in their soil studies are here suggested:

(1) What crops are best adapted to use on each of the types of soil on your farm? (2) If certain crops which you would like to grow are unsuccessful, determine, if possible, what amendments can be applied to the soil to make it suitable. (3) Discover the physical faults in your soil; if too tight or too loose, apply proper remedies. (4) Discover the very best rotation system for the permanent maintenance of your soils. (5) Discover the chemical shortages in your soil and supply the proper fertility. (6) Discover what legumes require inoculation before growth on your soils.

Problems to Solve in Soils Work.—Besides the discoveries such as those mentioned in the preceding paragraph there are many other problems to solve which are closely allied to farm management. A few are suggested:

1. What crops can be best grown on lands which are in danger of serious erosion?
2. How can eroded soils be redeemed yet produce crops during the process of redemption?
3. How can erosion already started be best stopped and prevented? (Figs. 125 to 128.)
4. How can one best determine the use of fields which seem to be non-productive for crops thus far tried on them?
5. The best use of marsh lands is a serious problem on limited areas in nearly all states.
6. Light sandy soils offer serious problems in crop production.
7. Many special problems arise in the growth of market garden crops and vegetable gardening, such as the best ways of increasing the humus content, maintaining friability, maintaining soil moisture, etc.
8. Problems of land drainage are often difficult to solve (Fig. 129). Will it pay to underdrain the land? Where can the water be carried? How can I get my neighbor to coöperate? How can I drain off water without his coöperation?
9. Would subsoiling increase yield of crops enough to pay for the labor?
10. Would liming of land increase yields enough to pay for the cost?

Discussions Relating to Soils.—Teach students to discuss soil problems at home. For example, have the class look over such soils problems as those suggested in the preceding paragraph and such points as those suggested in former paragraphs. Get them to take up these matters with their parents and neighbors. This will start considerable discussion among the people. It may cause a number of them to adopt better methods of farming. Lack of discussion is often one of the chief drawbacks to suc-

cessful farming. The thoughtful farmer ponders over many of these problems but is uncertain as to the best steps to take.

Fig. 129.—Students should practice running levels for drainage lines. (E. H. Thompson, Okla.)

Fig. 130.—Student practice work on the school land. (P. L. Guilbeau, La.)

Discussion will aid materially in reaching satisfactory conclusions. Get each member of the class to bring to the school many soil

problems of his own home place. Get each to inquire at home what soil problems and difficulties are in the minds of the owners. When these matters are brought before the class for solution they will stimulate much thought among the members and much profitable discussion may result.

Some debatable topics are plowing in fall or spring; early and late plowing for wheat; laying tile in fall or spring; time for plowing under a cover crop; harrowing soil before plowing. Think of others.[4]

Things to Read in Soil Studies.—After the members of the class have been induced to bring to the school many home farm problems, suitable references may be given them for reading about these problems. Some of the exact problems are doubtless discussed in bulletins and books to which the instructor can make reference. Students should be taught to look up many readings of this kind through the use of indexes of books and the tables of contents of bulletins.

FIG. 131.—Pursuing home projects for profit induces students to perform such work as spreading manure without objecting. (E. H. Thompson, Okla.)

Make lists of suitable articles on soil problems in the current agricultural journals. The topics discussed should be entered on filing cards with proper references. These cards may be used in making reading assignments to members of the soils class.

People of the community desiring to pursue reading in connection with soils may be given bulletins relating to the special topics they wish to investigate. The bulletins may be issued on library cards and returned according to the system of circulating libraries.

Observations in Soils Work.—When students have been well taught to observe carefully the many points in connection with soils work, many valuable lessons may be gained therefrom. They should observe closely the differences in soils and where one type blends into another. They should observe the effects of harrowing on soils that are rather wet and see how quickly the water will disappear downward. They should observe the effects of lime

[4] See topics for debate in Chapter XI.

when applied to heavy clay soils in the field. They should observe the direct influence of heavy applications of manure for such special crops as asparagus, strawberries, cabbages, and corn. They should observe the effects of sowing small grains on land that is too loose as compared with well-packed soil. They should observe the special effects of any usual or unusual forms of tillage. They should observe the effects of growing farm crops after clover in rotation systems.

Things to Do in Soils Work.—Farmers and students who are to work with soils should learn many operations by frequent practice, or in other ways, to make them skilful in soil operations (Figs. 130 and 131). Learn to run straight furrows in laying off lands for plowing. Learn to mark off rows well for planting fields.

FIG. 132.—This student learned at school how to operate and repair a tractor. He plowed land for a neighbor who owned the tractor, then rented it and plowed for his own project, for his father, and for others.

Learn to detect when soils are too wet or too dry for proper handling. Learn to plow well (Fig. 132), particularly in the turning under of crops and heavy applications of manure. Learn to prepare seed-beds well. Learn to maintain soil mulches perfectly. Learn to grow crops under level culture methods. Learn to kill weeds before they can be seen. Learn to handle manure without allowing it to leach or to heat. Learn to lay tile drains well. Learn to use the dry-land farming methods even in humid climates. Many other practices in soils may be suggested by instructors, and skilful operations may be learned by students.

Reference Books on Soils.[5]—Include on the reference shelves books on soils experiments at the leading experiment stations;

[5] See also Chapter XVII.

books on soils physics; books on farm management with reference to special types of farming; books on farm management with reference to crop rotations and soil maintenance; books on fertilizers and soil fertility.

Bulletins on Soils.[6]—Secure the latest lists of farmers' bulletins relating to soils and fertilizers from each of the state experiment stations and from the United States Department of Agriculture. The latter may be obtained from the office of Agricultural Education in the States Relations Service. Send for all of the available bulletins relating to the general subject of soils and soil fertility. These may then be classified according to the best system as suggested in another chapter of this book.

Journals Relating to Soils.[6]—A number of periodicals are published for farmers and for scientists which contain departments of miscellaneous articles on soils. Select the best of these for the particular purposes of the school. If these are carefully indexed from time to time, students can make good use of them in their work. As each periodical appears the articles relating to soils and fertilizers may be mentioned on sheets which are posted in a convenient place for the use of all. Let articles from these periodicals be reported to the class by certain students to whom the articles are assigned for reading.

EXERCISES

1. Make a list of laboratory apparatus to be used in teaching soils, that you could make or have students make.
2. Make one or more of these pieces of apparatus.
3. Take twenty samples of soils and subsoil, using several methods.
4. Get materials and weigh out quantities sufficient to make one hundred pounds of a definite composition, as 2–8–6. Mix these in the presence of the class or others.
5. Make three or more soils charts useful in class-room or farmers' meetings
6. Conduct a lime survey for a limited area.
7. Make three or more type lessons in soils.
8. Make a collection of soil samples, by mail or otherwise, including all the chief types of the state.
9. Write to the U. S. Bureau of Soils for a list of the soils maps of your state and get those which will be most valuable to you.
10. Perform three or more of the laboratory exercises in the presence of your class or others for practice in this kind of work.
11. Conduct an exercise for studying soils in the field.
12. Conduct a soil survey with such an outline as given in this chapter.
13. Make a drawing of a number of plots on the school land laboratory for the growth of plants used in the study of soils. Plan all details.
14. From the list of laboratory exercises given here formulate a course which you would give.

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[6] See also Chapter XVII.

QUESTIONS

1. State the specific aim in the study of soils.
2. What is the scope of this subject?
3. Tell something of the relation of soils to other agricultural subjects.
4. Suggest special methods in teaching soils.
5. Give a list of equipment for the course in soils work.
6. Mention a number of questions which arise while judging soil conditions in the field.
7. Give points for an outline of a lime survey.
8. Mention several kinds of soil containers: (*a*) for passing around samples in the laboratory; (*b*) for storing soils in the laboratory; (*c*) for exhibiting soil types on the shelves.
9. Review a type lesson in soils.
10. Tell how to prepare a garden compost.
11. Tell how to test soils for acidity.
12. Tell how to test soils for lime.
13. Give points to be included in a soil survey.
14. Suggest several subjects for soil charts.
15. How may lantern slides be useful in teaching soils?
16. Tell of the value of physics and chemistry in the study of soils.
17. Of what value are plot trials in studying soils?
18. Give suggestions for the teaching of soils in rural schools; in town grades.
19. Tell something of the content of a short course in soils in your locality.
20. Suggest things to discover in soils work.
21. What are some of the problems to be solved by students in soils work?
22. How can you start discussions related to soils, among students and their parents?
23. Give examples of supplementary reading related to soil studies.
24. What observations should students be taught to make in this subject?

CHAPTER XIII

HOW TO CONDUCT HOME PROJECTS

A home project should include each of the following: (1) There must be a plan of work covering a season or other extended period of time; (2) it must be a part of the instruction in agriculture of the school; (3) there must be a problem more or less new to the pupil; (4) the parents and pupil should agree with the teacher upon the plan; (5) some competent person must supervise the home work; (6) detailed records of time, method, cost, and income must be correctly kept on suitable forms; (7) a written report based on the record must be submitted to the teacher.

If a project is participated in by several students as a class or part of a class, it would be considered a *group project*. If the essential parts of the project are the work of one pupil, it would be called an *individual project*. According to the chief aim, projects may be classified as (*a*) productive projects in which the chief aim is to produce any agricultural product at a profit; (*b*) trial projects in which the chief aim is to test materials and methods in agricultural practice new to the student; (*c*) improvement projects in which the chief aim is to make improvement with hope of little immediate return; and (*d*) management projects in which the chief aim is to apply efficiently the general principles of farm management.—Condensed from Report on Agriculture of the N. E. A. Commission on Reorganization of Secondary Education.

So MUCH has been said in recent years regarding the value of teaching agriculture by home project methods that little need be said here regarding that phase of the subject. It was in the field of agriculture that the home project method of instruction was first successfully demonstrated. Agricultural projects have so frequently formed the basis for school-room instruction that few teachers will fail to realize the value of this plan of carrying on the school work.

The term project as here used involves the time element. An exercise performed in one laboratory period should not be considered a project. A number of exercises are sometimes combined and called a project, if they are closely connected with each other and lead to the same general end or aim.

In the broad sense, a project is a far-reaching aim. It is usually not made up of a series of similar exercises, but includes all studies, exercises, practices, operations—alike and unlike—which lead to a definite aim in the mind of the person doing these things.

Agricultural projects, particularly home projects, pursued by students who are studying agriculture should have the profit factor in them; as growing a crop of wheat for profit, raising a litter of pigs for profit, fattening a bunch of steers for profit, renovating an apple orchard for profit.

Improvement projects which do not always include the profit element are sometimes pursued by students. Sometimes mechanical projects are really, in the end, improvement projects or have maintenance features in place of the profit features.

Major and Minor Projects.—When students are performing long-time projects in any field of agriculture, these projects are often coëxtensive with the study of the particular subject in which that project falls, as laid down in the curriculum of the school. If a high school student, for example, is pursuing the subject of field crops for one year in his school course, he may raise an annual crop as his project—corn, wheat, potatoes, cotton. Such projects may be designated as major projects. These may or may not continue longer than the time devoted to the particular branch in the course. When horticulture is taught for half a year in the school the student may pursue a project in orcharding which will continue for one or more years.

The term minor project is used in two senses: (1) It is some operation or part of a major project, as spraying an orchard or marketing the crop; (2) it is a short-time project which is complete in itself, as buying a bunch of pigs and feeding them one month and selling them again.

Scope of Projects.—Whenever a student undertakes a project in agriculture he should formulate definitely the scope of the project, the limit of time—when it is to begin and when it is to end; the factors, elements, animals, or plants which are to be concerned in it.

The statement of the scope should be such that it will be consistent with the seasons, with the probable development of the crop, and of the animals being grown. It should be such that the probabilities of profit are favorable.

Who Agrees to the Project and Its Scope?—When students are living at home and studying agriculture in a school they may readily conduct home projects which are pursued all or part of the time during school months. They can pursue such projects more intensively during vacation months. The projects in such cases should be planned in coöperation with the parents and the agricultural instructor. All three should agree to the main features to be included in the project and the scope which the project is to cover. The father agrees to supply operating capital and the place for the working out of the project. The income derived from the project is to be used first to pay all costs of the project and

second, to pay the student for his labor, and third, to pay profits for good management.

The student and father both agree to follow the instructions of the teacher and to perform the operations in the project according to the best methods laid down in the references given by the teacher of agriculture.

Writing the Plans of the Project.—Not only the scope of the time and field to be covered by the project, but also the plans or steps to be followed in pursuing the work should be written at the beginning or very soon afterwards. It is not necessary that the steps be inflexible. Indeed, they should be quite flexible and subject to new conditions that arise from time to time in the progress of the work. It is safe to say that no "cut and dried" plan can be followed absolutely.

The value of having a plan made in advance helps both the student and the instructor to know about what is to be the progress of the work. The parent also will know better what is expected of the student. In one sense, it fixes the scope of the work better in the mind of the student and his father.

Project Operations.—After the scope of the project has been determined, the student, with the aid of the instructor, should first write out the steps in the project from beginning to end. These steps are really the project operations taken in order from beginning to end. They must have seasonal sequence, particularly if they are crop projects. The steps can be foreseen, to a great extent, when the project is planned. Of course, minor steps may be added later. When examined as a whole, some changes may be suggested and perhaps new or different steps may be planned for part of the work. The student may have omitted some important elements, as spraying, the use of fertilizers, the growing of a cover crop, or other step necessary for the success of the project. After the steps are revised and ready to be copied again, they should be written in the student's permanent project book.

Topics for Study Involved in Each Operation.—The instructor should show the student how to choose topics for study under each step of the project work. A rather complete list of these topics should be written in a notebook for each of the project operations. After the student has been shown how to begin his choice of topics he may be allowed to choose topics for the remaining steps in his project.

The student and instructor working together should review carefully all of the lists of topics and revise them. These should then be

written up carefully in such form as to leave room for citations, or references, to books and bulletins where the topics are well discussed.

Making Citations to Project Topics.—First, the instructor may suggest to the student a number of books and bulletins which discuss the general subject of the whole project. For example, if the project consists in growing a field of potatoes for profit, the instructor may give the student a list of references where potato growing is well considered—a few farmers' bulletins, certain books devoted to potatoes, as Gilford and Grub, and Frazier. For the fertilizing of potatoes one or two authors on fertilizers might be cited. Some books on general field crops might be included in the list given to the student. After receiving this list from the instructor, the student should take each of the topics, find where they are discussed in several of these bulletins and books and write, in a suitable place, after the topics the author and page. Without stopping to study these, he may go on through the entire list of topics and write out the citations in definite form for future study.

Project Book Forms.—Various project books are published or forms suggested by state supervisors, by teacher training departments in colleges, and by the Federal Board for Vocational Education. The outlines suggested by the plans published in this chapter are not intended to be followed by students in their actual pursuits of project work. They are merely suggestive and should be revised and written into the student's notebook, or project book.

Published Outlines of Projects.[1]—Several state boards for vocational education have published outlines for project studies. Write to your state supervisor for such as are available. The published outlines should not be considered as suitable to all schools nor to all farms where such projects are pursued. They should be revised to meet special conditions. Even the scope of the outline may not be the same as will be desired by the student, parent, and instructor. The purpose of published outlines is to suggest to students topics for projects, steps in the operation, topics which may or may not be included, and perhaps direct the student roughly in the details of making citations.

After the student and instructor revise one of these published outlines to suit the particular farm where the project is to be pursued, it is still subject to further revision as the project progresses.

Keeping Notes of Topics Studied.—If state forms are published for keeping notes on the topics studied, they should be used by

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[1] See Lathrop's "Manual and Notebook on Field Crops."

students in schools. If no such forms are published, the instructor should designate what type of notebook will be best for the purpose and topics to be outlined. Topics studied should be outlined in a notebook. Perhaps the notes that differ from each citation for that topic may be kept distinct, but not necessarily so. These notes should be used by students in reporting their topics to the class. Some state forms require that the notes on citations from different places be kept distinct. When this plan is followed, the number of the bulletin and the pages read should be given for each outline or title studied. If the references are to books, papers, and magazines, the citations in each case should be written with the notes taken by the student in studying that topic.

Record of Performance of Project Operations.—Students should be taught to keep notes under such a head as this, in their notebooks or in special state forms. If the project be with crops, the kind of notes taken will be very different from those taken with animal projects. In the latter type of projects the notes will relate more to daily operations, changes in operations, variations in plans, and reasons for them.

Observations on the Project.—One section of the student's notebook should be devoted to observations on the project and may be headed in this way if desired. Many observations may be made which will be of value to the student making them. Students should be encouraged to become observant and should be taught to write the notes on their observations intelligently and in good form for use in reporting to the class, or to the instructor from time to time.

Summary of a Project in Crop Production.—The student should keep notes for filling an outline in his notebook which would include a number of points such as the following:

1. Total area in project.
2. Total yield.
3. Pounds of seed used.
4. Tons of manure used.
5. Pounds of fertilizer used.
6. Charge for use of land.
7. Total value of the crop.
8. Total cost to grow and market main crop.
9. Returns from by-products, as stover, straw, etc.
10. Net profits (total charge less total credits).
11. Net loss (total credits less total charge).
12. Number of man-hours.
13. Labor of self.
14. Labor of other help.
15. Total number of horse-hours.
16. Number of tractor-hours.
17. Machinery charge.

Summary of a Livestock Project.—Keep notes for filling a report or summary of a livestock project, including such points as the following:

1. Number of animals at the beginning of the project.
2. Number near close of the project.
3. Average number during the project.
4. Total production in pounds of pork, of milk, of beef, dozens of eggs.
5. Cost of producing milk, eggs, beef, pork, etc.
6. Total cost of keeping livestock.
7. Depreciation on livestock.
8. Value of products marketed or used (eggs, pork, beef, milk, etc.).
9. Appreciation in value of livestock.
10. Pounds of grain (concentrates fed to livestock).
11. Pounds of roughage fed to livestock.
12. Allowance for pasturage of livestock.
13. Total number of man-hours of labor.
14. Labor of self.
15. Labor of other help.
16. Total number of horse-hours.
17. Net gain or loss.

Uniformity in Prices Allowed for Feed and Labor.—In the forms printed by some states for making a summary of projects, sometimes the prices to be allowed per hour for horse labor, for student labor, and for hired labor are fixed. This is for the sake of uniformity in reports handed to the state departments from all the schools.

In like manner, the prices to be allowed by students for pasturage of various kinds and for different types of animals are sometimes designated by state authorities. In cases where prices are not thus fixed, the rates allowed in the reports should be uniform in each school. Some idea of the amount to be allowed may be obtained by getting the forms from other states which publish them freely. Write to your state supervisor or to states where prices have been designated.

Prices for feed may be determined very closely by market values, which vary from time to time. Really the student should use actual cost values for all feed which is purchased in the market. It is for feeds which are grown upon the farm that standard prices or uniform prices should be fixed.

Analyzing the Results of the Enterprise in Crop Production.—The student should keep notes of all details concerning his project in suitable form so that the results can be carefully analyzed and a report made which would include such points as the following:

1. Yield per acre.
2. Amount of seed per acre.
3. Tons of manure per acre.
4. Pounds of fertilizer per acre.
5. Charge for use of land per acre.
6. Cost per acre of growing and marketing the main crop.
7. Cost per acre of production of by-products (straw, stover, etc.).
8. Cost per unit of main product (as ton, bushel, etc.).
9. Cost per unit allowed for by-products (divide 8 and 9 on market value basis).
10. Rent of land is what per cent of total cost of crop?
11. Labor cost is what per cent of total cost?
12. Fertilizer cost is what per cent of total cost?
13. Cost of equipment per acre.
14. Human-hours per acre.
15. Horse-hours per acre.
16. Profit or loss per acre.
17. Profit per man-hour.

Analyzing the Results of a Livestock Enterprise.—Keep full notes so that the following details and others may be gleaned and reported in the final analysis:

1. Pounds of milk per cow; pounds of meat per head; number of eggs per hen.
2. Pounds of butter fat per cow (test × weight of milk).
3. Average test of milk produced.
4. Value of products: eggs per hen, milk per cow, meat per head.
5. Cost of products: cwt. of milk, of meat, dozens of eggs.
6. Cost of keeping a cow, hog, hen, etc.
7. Pounds of concentrates per hen, hog, cow, etc.
8. Cost of roughage (or litter) per hen, hog, cow, etc.
9. Cost of pasture per hen, hog, cow, etc.
10. Net profit or loss per head.
11. Profit per hour of human labor.
12. Hours of man labor per head or per hundred hens.

Keeping Records in Project Work.—If reports such as are suggested under the foregoing headings are to be made at the close

Fig. 133.—This student rented his father's equipment and produced a large field of wheat with profit. Much of the work of a winter wheat project falls in the vacation season. (Avery Co.)

of the project, it will be necessary for students to keep records of many things. In most cases daily records of items will be necessary.

Labor records should show how much time was put upon the project by the student himself and by others. The kind of work performed should also be shown on this record sheet. The price allowed per hour for the labor is to be stated.

Horse labor used in the project should be shown by dates and the kind of work being done each day, as preparing fields for seeding, hauling manure, planting crop, harvesting or marketing. The price per horse-hour is to be stated.

Tractor work, if any, should be charged up against the project. Give rate per hour, kind of work, and number of hours (Fig. 133).

Feed Record Forms.—In animal projects it is important that accurate records be kept of the feed of different kinds which is used and the prices charged for the feed. The feed may be grouped under three main heads; concentrates, roughage, and pasturage. Sometimes it is advisable to include special items for bedding, for slops or other wastes, for root crops, etc. Ruled forms may be made so that weights of feed may be entered on each day of the month and for each of the twelve months of the year. Prices per pound may be indicated at the bottom of the column for each month. A summary of the feeding may be made for each month. This will make easy the final summary at the close of the project.

Milk and Butter Records.—In dairy projects (Figs. 140 and 141), milk records should be kept either weekly or daily. The weights should be recorded for each milking, about one day a week, and butter fat tests should be recorded on the same dates for each test made. Multiply the weights if made one day a week by seven to get the total weight of milk for the week. Multiply the percentages of fat shown by the test by the weight of milk for a week to get the butter fat production for the week. Add the daily or weekly production of milk and fat to get the yields in these products for a month.

The cost of feed for any individual cow each month may be compared with her production computed at market prices. The profit or loss from each cow for each month is thus determined. Suitable forms for this work may be obtained from the dairy divisions of state experiment stations and the United States Department of Agriculture.

Records of Weight of Animals.—In feeding experiments with pigs, sheep, beef cattle (Figs. 134 and 135), etc., stated periods for weighing the animals to obtain results of feeding should be decided upon in advance. Suppose weighings are to be made once a month or once a week, suitable forms may be easily ruled on sheets fastened to a board which will hang on a wall or other convenient place. Copies of the weight should be transcribed by the student to the project record book to prevent loss.

Poultry Records.—In conducting poultry projects forms should be made or published forms may be obtained to record easily the number of eggs produced, raising of chicks, etc.

Forms are published for keeping records of incubators and brooders.

Special Forms for Other Projects.—It will be easy for a student or his instructor to devise suitable forms for use in keeping records

for any special projects that are undertaken. It is good practice for a student to plan his own forms for record keeping. Let the records be ruled to suit the project and placed where they will be convenient for use.

Charge for Use of Machinery.—Make memoranda on some simple ruled form for keeping a record of the kinds and amounts

FIG. 134.—The animal husbandry class of the high school fed these four steers as a group project. (O. E. Stephel, Minn.)

FIG. 135.—The school steers were slaughtered, the meat sold, costs and returns calculated, and profit shown. The agriculture teacher was an expert in animal feeding and in meats. (O. E. Stephel.)

of use of farm machines (Fig. 136). The number of hours that each machine is used should be recorded. Note the condition of the machine at the time. State the price to be allowed for use of machines of each kind.

Cost Accounting.—Many of the elements in cost accounting have been suggested in the foregoing paragraphs. If complete records are kept of the different elements which enter into the production

Fig. 136.— Some pictures taken of the different stages in the progress of each student's project. These pictures can be mounted on record charts in the school-room, used in the student's final report, and published in local press from time to time. (J. B. Roller, Va.)

of any crop or farm product, the summary of the cost of production can easily be calculated at any time for any given period.

It is important that the forms which are used punctually to keep accounts of different items of expense be filled. If this is done regularly, the student will not feel that cost accounting is a difficult task. Students should be taught to keep records carefully and yet they should not be made to feel that the drudgery is so great as to make them dislike the work and declare they will never keep such records when they are in business for themselves. The best result of cost accounting by school students is to teach them to form life habits of cost accounting. They should learn that the right methods are easy and worth while. The present lack of cost

Fig. 137.

Fig. 138.

Fig. 137.—The vocational instructor on his round of visits to the home projects should take notes from students' records and from the work for use in class work and to report to the local press. (S. R. S., U. S. D. A.)

Fig. 138.—Vocational instructor's car at home of student who has just selected his white seed corn. The car belongs to the county and is lettered "Cape May County Vocational School of Agriculture." This instructor takes books and other equipment with him. (A. W. Hand.)

accounting on American farms should be overcome by right teaching of simple methods.

Records of Income.—In many projects in gardening, dairying, small fruits, orcharding, etc., special forms should be made for keeping records of sales of products. These should provide for the amount and kind of articles sold, prices per unit received, and places for totals per week or month. Records of incomes from projects can thus be simplified and summaries can be easily made out any time desired for the student, parent or instructor.

Calculating Labor Income.—To determine the "labor income" for a season or at the close of a project, the student should find the total income from all sales and from this deduct all the items

of expense except his own labor. To find the "net income," deduct from this a fair amount for his own labor.

Visits to Projects.—In teaching vocational agriculture, the instructor should visit the farms where students are pursuing projects (Figs. 137, 138, and 153). These visits should be made with sufficient frequency to insure the right conduct of the project. No wrong steps should be taken by the students because of the neglect of the instructor to visit the project work at the proper

FIG. 139.—Growing corn for profit has been the most popular home project of students. Thousands have chosen this project. More variety will help the school, the students, and the farmers. The Minnesota boy at the left is running a special seed corn project, and has de-tasseled some of the rows. (Right from T. G. Brown, Wis.)

time. The frequency of visits will depend largely upon the season of the year. This is particularly true in the crop growing projects. In animal husbandry projects the visits may be more evenly distributed through the season.

Attitude of the Instructor When Visiting Projects.—The spirit of helpfulness, encouragement, and stimulation should be uppermost in the mind of the agricultural instructor when he is visiting the project work of his students. He should maintain this attitude toward the student himself, toward the parents, and toward neighbors whom he may meet on his rounds. He should always feel that he is there for the good that he can do and for the help that

he can give. He should impress corrections kindly. This may often be done by contrasting with other neighbors or other students that are doing better with similar projects. He should avoid participation in neighborhood controversies. He should avoid discussions of superstitious beliefs which are in the minds of neighbors or parents. In place of this, he can firmly insist upon scientific methods being followed without trying to controvert wrong beliefs. Better results will thus be obtained.

The agricultural instructor on his rounds may do much good in every community. Many questions will be brought to him if he is a suitable person for his work. He should not restrict his

FIG. 140.—A dairy project with four pure-bred Jerseys keeps a high school boy very busy. (A. A. Sather, Mo.)

work to particular projects of his own students. He should be willing to help along all the agricultural projects of the neighborhood, so far as his time and energy and store of knowledge will permit. In Chapter XVIII are given suggestions for conducting community work.

Instructor's Relation to Notebook and Record Keeping.—When visiting a student's project the special records kept for that project should all be inspected by the instructor. If mistakes are being made, they should be clearly indicated and carefully noted for improvement in the future. If possible, suggestions should be offered to simplify the records and make them easier to keep. Accuracy and punctuality in keeping records of cost and income should be emphasized whenever students are lax in such matters.

The project notebooks of students should be examined somewhat regularly so that students will be induced to keep their books in condition for inspection. Postponement of notebook work should be discouraged.

Written and Oral Instructions.—When each visit is made to inspect project work, oral instructions should be given the student after all points of the work have been gone over and discussed. Finally a brief written record of the main points should be left with the student, a copy of which is kept on a carbon sheet by the instructor for future reference. This written record should include (1) the mistakes in methods which the student has been making and which he is instructed to change; (2) the steps which he is directed to perform next; (3) suggestions regarding production, marketing, or other processes yet to be performed.

This written record of instructions will be signed by the instructor and will bear the date of the visit. This becomes the record of the visits made by the instructor and will enter into the student's project report.

Fig. 141.—Students with Holsteins in their dairy projects, Vanceboro, N. C. They wear white suits and believe in producing clean milk. (H. L. Joslyn.)

Project Score Cards.—In each type of project or for each general subject in agriculture a project score card should be formulated by the instructor to suit the local conditions. Classify the projects being pursued by the students. Announce that all the students will be scored on the progress of their work. In all of these score cards the instructor may allow 25 per cent for points in production, 25 per cent for record keeping, 25 per cent for marketing and profits (labor income and net income), and 25 per cent for summaries or history or stories of the project work. The latter should include reasoning and application of fundamental principles. It is on the first twenty-five points that the score cards for different kinds of projects will vary. This part of the score card may be separated into many subdivisions. Include such points as mastery of new methods, use of related knowledge, interest in work, interest in science, coöperation, economical use of time, exercise of judgment, systematic performance of duties, punctuality, facility in performance, and skills developed.

Encourage the spirit of competition among students. They

should feel that the approbation of the teacher is worth while. The score cards will enable the instructor to compare more accurately the work of all members of his class. The final results of students, even if pursuing different kinds of projects, may be compared if the work is scored on the basis here given or any similar plan.

In using the score card the work should be divided into two factors: (1) Those over which the student has little control, as weather conditions and unforeseen accidents; (2) those for which the student could be held directly responsible. Thus the efforts

Fig. 143.

Fig. 142.

Fig. 142.—A pure-bred Holstein calf worth $200 when born is only a part of a good dairy project. (T. G. Brown, Wis.)

Fig. 143.—A junior project for a club boy may be with only one pure-bred Guernsey calf. (T. G. Brown.)

of individual students may be judged and properly credited. The instructor will need to jog constantly his own memory with reference to points to be considered when criticizing or commenting upon the projects and in scoring them. Otherwise he may overlook points that would escape his notice.

How to Visit the Work of Students.—The instructor must have some means of conveyance. In some cases instructors use bicycles, in others motorcycles. Some instructors go on horseback, some use automobiles (Figs. 137, 138, and 153). The condition of roads in different sections of the country and at different times of the year is an important factor in determining the means of transportation. The cost of traveling also enters largely into the problem. In a very few

cases, interurbans, trolleys, and railroads are found convenient enough for extensive use in this work. Walking from various centers of transportation is sometimes resorted to by teachers of agriculture.

FIG. 144.

FIG. 145.

FIG. 146.

FIG. 144.—When a student keeps pure-bred pigs, builds a hog cot, produces a pasture, and otherwise manages a sow and litter, he has a good educational project. (Guy S. Ellis.)

FIG. 145.—A Wisconsin pig-club boy with pure-bred pigs that hold his attention. (T. G. Brown.)

FIG. 146—Teach students that the greatest profit in pig projects is obtained when pigs are raised on clover or other good pasture. (W. C. Christensen, Wis.)

Taking Students to See the Work of Others.—Much benefit may be gained by students in the same kind of work visiting the

enterprises of others. They learn by example what good points to follow and what mistakes to avoid. Let every student visit every successful project in the vicinity. Farm operations and projects of graduates and former students may be included. Let

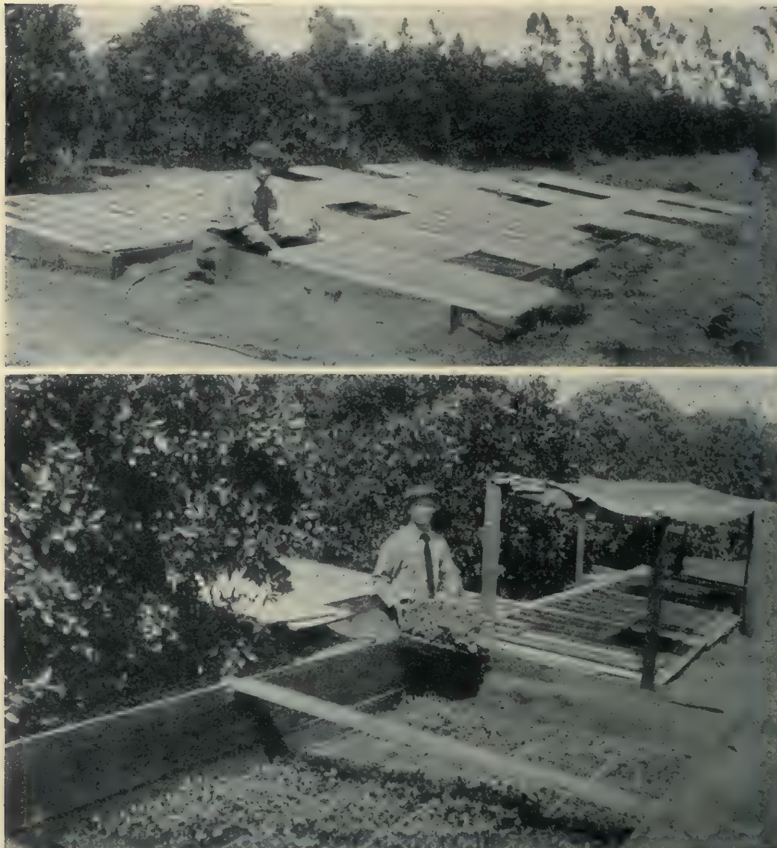


Fig. 147.—Plant propagation has been chosen by this boy as a life work as a result of a project which began with a propagating frame 3 by 6 feet in size, Ontario, Calif. (Chas. J. Booth.)

them carry score cards or outlines which will call their attention to each particular point in the work.

Some of the students may have conveyances to assist in taking the students around. If the roads allow the use of automobiles, the problem of visiting projects is an easy one.

Suggestions for Projects with Field Crops.—Grow for profit any farm crop of the region. Annual crops for such projects may be corn (Fig. 139), wheat, Irish potatoes, sweet potatoes, oats,

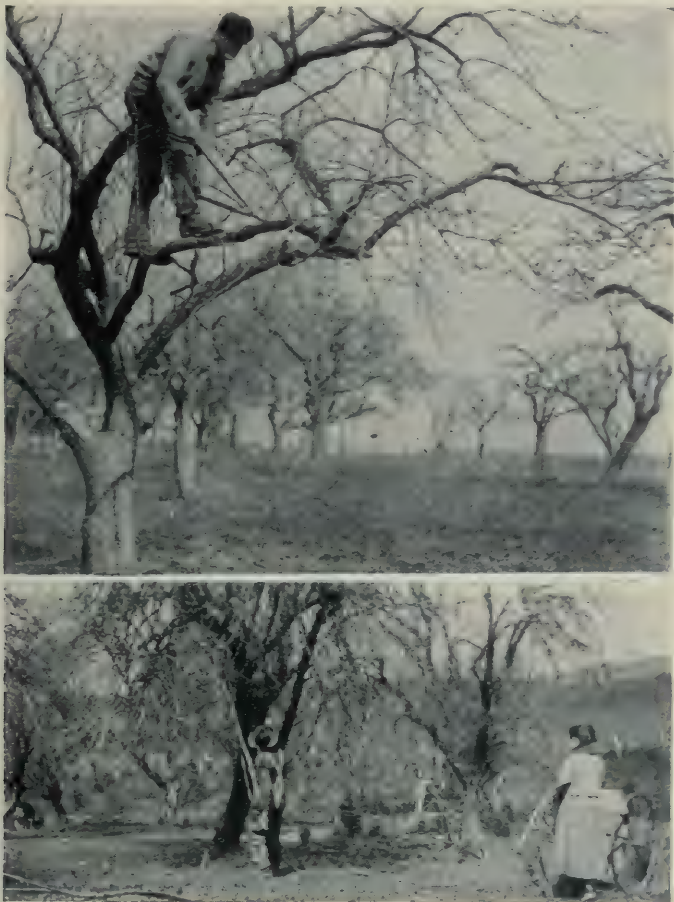


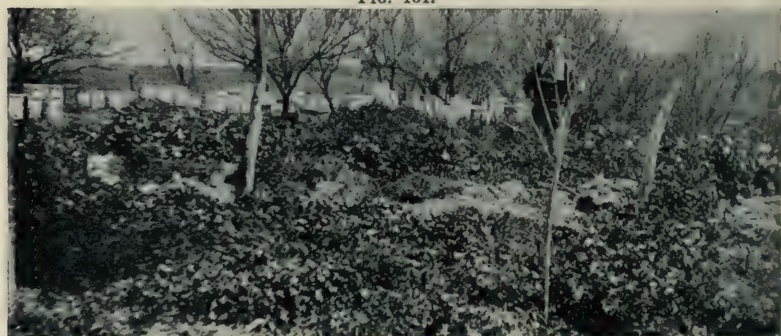
Fig. 148.—Projects in the renovation of old apple orchards may be very profitable to students and the orchard owners. (A. W. Hand, N. J.)

barley, sorghum, and sugar-beets. Perennial crops may be grown either their first year or may be taken over by the student after they are established. Such crops may include alfalfa, clovers, timothy, orchard grass, etc.

Fig. 149.

Fig. 150.

Fig. 151.



Figs. 149–151.—Project work in bee-keeping, Florence High School, Arizona. Fig. 149.—Building hives. Fig. 150.—Landing of heavy laden bees. Fig. 151.—Student with bee veil doing his work. He cleared $3000 in one season on his project. (V. B. Anderson.)

Grow for profit combinations of crops, as the following companion crops: Oats and rape, cowpeas and millet, oats and vetch, cowpeas and sorghum, grass mixtures, corn and cowpeas, corn and peanuts, corn and velvet beans, corn and soybeans. The following groups of succession crops may be used:

Wheat followed by clover, potatoes followed by winter wheat, early potatoes followed by buckwheat, oats followed by buckwheat, crimson clover followed by potatoes, crimson clover followed by corn.

Any of the projects with crops may be accompanied by special

Fig. 152.

Fig. 153.

Fig. 152.—Encourage bee-keeping in home project work. This is an ideal site for the apiary. (C. J. Booth.)

Fig. 153.—Automobile expense is one of the troubles of the teacher of vocational agriculture while visiting home project work where the roads are poor and bridges are lacking. (H. A. Savage, Ala.)

treatments for demonstrations of particular features, as liming, fertilizing, or comparing varieties (Fig. 139).

Projects in Soil Improvement.—Rundown farms, abandoned fields, or gullied fields may serve as subjects for projects in soil improvement. In such cases it is fair to assume that the project may be a profitable one. But in order to closely approximate the profit from the improvement it is advisable to have a committee appointed at the beginning of the work to assess the value of the land. Let the same committee make a subsequent assessment after the project has been completed.

Steps in such projects will have to be planned to suit individual cases. They may consist of any of the following operations: Clearing of brush, removing of stumps, piling up or hauling off stones, stopping gulleys, terracing, growing cover crops, using green man-

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ure, spreading manure and fertilizers, liming, good tillage, and establishing improvement crops, as legumes.

Projects with Dairy Cattle.—The following suggestions indicate the scope of a number of profitable projects in dairying:

1. Care for, feed, and manage four or more dairy cows for twelve months (Figs. 140 and 141).
2. Improve a dairy herd by culling out the poor cows after keeping records, tests, and figuring the feed bills for individual cows of the herd for a period of twelve or more months.
3. A dairy feeding project may consist of working out good rations for dairy cows and using them for twelve months or more with the members of a large herd. The amount of feed weighed to each cow daily should be compared with the records of milk produced. Compute the saving due to adapting the amount and kind of feed to the individual animal.
4. In a very large herd, let the student do the buying of feeds and keeping the records for the entire herd.
5. Operate the separator, make butter, and take charge of marketing all products for a period of twelve months. The price of the raw product may be fixed and the profit may come from the manufacturing and marketing.
6. Let one or more students of the class run a small cow-testing association for a year. The profit to the student would come from the money paid by the members of the association for this work.
7. Feed and take care of the calves of a dairy herd for one year (Figs. 142 and 143).
8. A minor project may consist of preparing dairy cows and calves for exhibit, showing them at a fair for premiums.

Projects with Hogs.—A number of profitable projects in connection with the swine industry are suggested here:

1. Fatten meat hogs for home use, dress and cure the meat.
2. Raise and market one or more litters of pigs and sell them for market or for breeding (Figs. 144 and 145).
3. Raise three or more pure-bred sows and sell their first litters after registering them (Fig. 146).
4. Keep all hogs on a swine farm free from internal and external parasites for six months. Make a dipping vat and sanitary wallow. This project may be made to include all diseases, as treating for hog cholera.
5. Make all troughs, feeders, platforms, pens, loading shoots, and other structures needed on the hog farm (compensation on mechanic's basis).
6. Grow a series of hog pastures to maintain good pasturage for a period of six months and graze a lot of hogs on these. This project may be extended over a period of twelve months and include winter pastures where possible.
7. Finish a bunch of ten or more hogs for the last ninety days and sell them.
8. A good project may consist of killing, curing, and marketing meat from a farm where swine is one of the chief products.
9. Prepare a bunch of pure-bred swine for exhibition at a large fair and exhibit them for premiums.
10. Kill and manufacture pork from a farm for one year, making the three products, lard, scrapple, and sausage; put up in fancy packages for city market. Use a trade name in this project.

Projects with Beef Cattle.—Profitable projects in study and management of beef cattle may be conducted by students pursuing animal husbandry.

1. Buy a bunch of steers, *e.g.*, one carload, age about eighteen months each, feed these over winter and fatten them for the spring market. Or use a small number and finally butcher them and sell the meat (Fig. 134).

2. Raise a bunch of beef calves, beginning at weaning age, until they are ready for baby beef at fourteen to eighteen months of age.

3. Select and buy three or more shorthorn cows with calves at side. Register the calves, prepare the bunch for sale, and sell them at the end of a year.

4. Prepare a bunch of pure-bred cattle, Angus, Hereford, or Galloway, for exhibition at an important fair and show them for premiums. Animals of several different ages should be included in this project.

Projects in Sheep Raising.—In regions where sheep production is for meat, students may plan valuable projects in this line of animal husbandry.

1. Care for and manage fifty sheep for one year.

2. A minor project may consist of marketing wool, meat, and selling some breeding animals for a period of twelve months from the home flock.

3. Keep records and pedigrees and attend to registering the animals in a large flock of pure-bred sheep. This project may also include the selling of animals for breeding purposes.

4. Prepare a large bunch of sheep of different ages for exhibition at a fair and show them for premiums.

5. The erection of a modern sheep shed with good floor drainage, the making of feeding troughs and hay racks may be included as a part of one or another of sheep projects.

6. Keep sheep of a large sheep farm free from disease for a year. This may include making and using a dipping vat, the planning and growing of a series of pastures to be used in rotation to prevent stomach worms.

7. Buy lambs in the fall, fatten them during the winter, then shear and market the wool, pasture and feed the flock for sale in the fall.

8. Plan a project in the production of hot-house lambs. This may follow the preceding project by breeding some of the ewes mentioned in No. 7.

9. A student may undertake to serve the community as a sheep expert in selecting breeders, protecting flocks from disease, dipping, buying concentrates, planning pastures, shearing, and serving as market agent for products.

Projects with Horses.—The natural interest which students often have growing colts, managing horses and mules, makes them often wish to pursue a project in one of these lines.

1. On a large farm employing many work animals a student may be employed as an expert in feeding, watering, bedding, and pasturing all horses or other working animals on the place. This may be for a period of a year. The profit in the project may come from the pay he receives.

2. The foregoing project may have added to it the care of the harness, including repair, upkeep, fitting to animals, etc.

3. Raise and break one or more pairs of colts for two years. These ought to be of different ages.

4. Care for and manage three or more pure-bred brood mares, preferably of the draft type. Include the breeding of the animals, raising of colts, trimming of hoofs, care of both dams and foals.

5. A student may undertake to serve as expert for his community in caring for the work horses and mules, preventing diseases, treatment of common ailments, clipping, etc.

6. Prepare a number of pure-bred animals for exhibition at a state fair or other important fair. These should, if possible, include such animals as mentioned in No. 4 above. Exhibit the animals for premiums. This should include the registering of the foals before fair time.

Poultry Projects.—Less capital is required in starting projects in poultry than in most other lines of animal industry. Farms are often found more or less equipped at the beginning with some features of a poultry plant. These projects may also be pursued in villages or in suburbs of cities. The projects may be conducted by both young men and young women. There are many types of poultry projects, a few of which are suggested here.

1. Take charge of and operate the farm poultry plant for one year.

2. Select and purchase laying stock for a good flock. Use the trap-nesting system and keep records of results for one year.

3. Begin with incubators, hatch and grow for one year a flock of pure-bred chicks. This should include proper management of young stock, disposal of males for broilers, selection of females for laying, installing them in laying quarters for the winter, and the winter production of eggs from these pullets.

4. On a large specialized poultry plant undertake to operate a number of incubators and brooders and keep them in repair; repair and maintain the houses, feeders, trap nests, doors, gates, and fences for one year. (Compensation for repair work at mechanic's rates.)

5. A project in sanitation may be pursued on a very large poultry plant by keeping the flocks of poultry free from all vermin and disease for one year. Disinfecting houses, soil, rotating yards; trapping or shooting enemies, etc., may be included.

6. For a large plant work out scratching rations, dry-mash rations, purchase the ingredients and prepare these rations for one year. Collect and market the eggs, and market other products and keep the records during this year.

7. Hatch, grow, and fatten for market a flock of broilers. This may include fifty or more. It should include dressing, conditioning, and marketing, with records and with reports.

8. Hatch, grow, and fatten for market not less than fifty turkeys. This may include dressing and marketing.

9. Plan a similar project with geese or with ducks.

10. Hatch with incubators and sell baby chicks through one season.

11. A similar project may be planned in custom hatching for other people during a season.

12. Plan a project with pure-bred poultry, beginning with the laying flock. This may include the advertising and sale of eggs for hatching of day-old chicks, of cockerels, the selection of pullets for the next year's flock, and disposal of culls.

13. Prepare pens, trios, pairs and single birds of one or more pure breeds for exhibition at shows. Exhibit them for premiums.

Projects in Vegetable Gardening.—It is easy to suggest many projects in the growing of vegetable crops for profit. It is almost needless to mention them here. A few suggestions, however, will bring to mind many others with other garden crops.

1. Raise one to five acres of Irish potatoes; include the combating of enemies, harvesting and marketing the crop. This may, if desired, include the feature of storing a part or all of the crop for sale in the winter.

2. A very profitable project may be to grow an acre of onions from seed and market the product. A similar project would be to grow a half acre of onion sets from seed. Near a large city where green bunch onions are readily sold these may be grown from sets and marketed in early spring.

3. Raise for sale hotbed plants, including cabbage, cauliflower, head lettuce, peppers, eggplant, tomatoes, sweet potatoes, kohl-rabi, etc. The marketing of these at retail or at wholesale stores should prove to be a profitable project (Fig. 147).

4. In regions where there are canneries, projects in the growing of products used by the cannery should be undertaken. These may include growing of specified areas of peas, snap beans, lima beans, cabbage, tomatoes, sweet corn, cucumbers, etc.

5. The growing of special crops of one or two kinds for nearby markets may include any of the usual market garden crops, as watermelons, cantaloupes, rhubarb, asparagus, sweet corn.

6. Grow two acres of pop-corn and sell the same in ripe condition during the winter.

7. Grow a good home garden of all the best kinds of vegetables for this purpose. The records of amounts used at home as well as those sold may be kept and charged at market prices.

8. Plan projects in succession cropping of garden vegetables. Let short-season crops of the early vegetables be followed by hot weather crops. Examples of the first group are radish, lettuce, early peas, early carrots, English peas. Examples of the hot weather crops that may follow the others are sweet corn, pop-corn, beans, okra, tomatoes, peppers, melons. If desired, late crops that will grow after frosts may be used in the fall garden, particularly in central and southern states. The third group might include turnips, collards, radish, lettuce, cabbage, cauliflower.

Projects with Small Fruits.—The conducting of projects in small fruits may best be made to cover more than one year. If the crops be taken at a more advanced stage, a single year may be devoted to the project and this may be the year in which the sale of a crop is included. Several suggestions for the scope of small fruit projects are here given:

1. Begin with a newly set patch of raspberries and grow them for two years, including the marketing of the crop the second year.

2. Take a raspberry patch that is already of bearing age and manage the business entirely for one year, including the care, winter pruning, combating enemies, harvesting, marketing, and accounting.

3. Projects similar to either of the above may be planned with an acre or half acre of blackberries or strawberries.

4. Take a vineyard of bearing age and conduct the business for one year. Let the work include the growing of a cover crop, winter pruning, combating

enemies, repairing trellises, tying up growing canes, harvesting the crop, marketing, and reporting accounts.

5. One of the best plans for projects with small fruits is to have students conduct at least two projects with the same kind of crop. Let one of these begin with the bearing crop; let the other begin with the starting of a new plantation; thus all phases of the work may be included in one year of practice.

Projects in Orcharding.—The time to begin with a home project in orcharding is most naturally at the starting of the orchard. As this would require so much time to secure a profit to the student, it is difficult to interest the student in projects beginning at that time. Several suggested plans are here presented:

1. Start with two small projects in orcharding. Let one begin with planting a young orchard and let it continue for one or more years. The other project paralleling this should begin with a bearing orchard. Both will include all details of orcharding, but the second will be the one from which a profit should be expected. An orchard project of this type may be in peach growing, apple growing, pear growing, plum growing, or may be a combination of any of these.

2. Begin with an old apple orchard on the home place. Renovate it, rejuvenate the trees, and market the fruit. This project may be conducted for one year only, provided the trees are not too badly neglected to produce a crop the first year. Otherwise the project may be conducted for two or more years so that real results may be attained (Fig. 148).

3. A minor project may be conducted in a large peach orchard of harvesting, sorting, packing, and marketing the peach crop for one season.

4. A similar project for one season may be planned for an apple orchard, including the same features. It may also include a project in storing for winter sale.

5. On places where there is no bearing orchard a profitable project may be planned in the starting of a young orchard of one or more kinds of fruit. The value of the orchard should be assessed by a committee at the end of the project. This project should really be conducted for two years if possible.

Bee-Keeping Projects.—Spring is a good season for active operations with colonies of bees. If a student selects either a large or a small project in bee-keeping, he may find much study and work for the winter season. He will find his time more fully occupied in the honey-making season (Figs. 149, 150, 151, and 152).

Nursery Projects.—Very profitable undertakings may be made in the growing of nursery stock. Remember to observe state inspection rules. Several projects are suggested here:

1. In the winter make several thousand root grafts from scions and roots which have been stored for the purpose. Grow these in nursery rows in the garden the following season and sell the young trees in the fall.

2. Grow seedling stocks of peaches, plums, cherries, or apples. Bud these in the open in September. Grow the improved varieties for one season and sell the young trees in the fall of that year.

3. Make root cuttings of blackberries and grow the plants for one season and sell them in the fall or spring.

4. Tip layer black raspberry bushes after the harvest season and grow the young plants the balance of that season and sell the small plants in the fall or spring.

5. Propagate strawberry plants by runners, select the best plants, dig, properly label, and sell to neighbors.

6. Make root divisions of red raspberries and sell the plants.

7. Make cuttings of currants, gooseberries, and of many ornamental shrubs, grow these in garden rows for one or two years and sell the plants.

Projects in Landscape Gardening.—How to make projects of this kind profitable is suggested in some of the following:

1. If home premises are rather barren of shrubbery, vines, flowers, and lawns, have an assessment committee inspect the place before the beginning of the project, and at the end of it this committee should be able to determine the increased value of the premises as result of the landscape project. Let the first project consist of replanning the roads and walks, starting the vines, and seeding lawns.

2. A similar project may include much of the above and in addition plant a number of shrubs in masses about the main residence, at the angles of walks or roads, or in clumps to hide unsightly buildings.

3. Another feature of either of the above projects may be the painting of the residence, whitewashing of barns or other buildings.

4. Still another feature of any of these landscape projects may be the repairing or building of fences, the planting of trees, or the erection of trellises for vines.

Projects in Farm Management.—The profitable side of a number of projects in farm management may be seen in some of the following suggestions:

1. Keep books and records of costs and income from any one crop on your father's farm for one year. This may be done on a percentage basis or may be for a stipulated amount per hour of time used.

2. Let this bookkeeping include any record of cost accounting for the farm and sale of products. Crops fed or used on the farm should also be recorded. A complete summary at the end of the year should be made.

3. On a livestock farm keep records on special forms as well as book accounts of cost, sales, and profits for one year. The records of breeding of animals, birth of animals, production of individual cows, etc., may be included in this project. A record of the cost of the family living may be made for one year. Show what part of this comes from the farm itself and what part is purchased.

4. A variation from the preceding project may consist of comparing the cost of living with and without a home garden.

5. If the father's main project is the selling of pure-bred livestock, keep the cost accounts and sales for one year.

6. Plan and direct a profitable rotation of crops for three or four years, using as many fields as there are years in the rotation. Keep a full record of each of these crops as to cost and profit and compare them. This project may be reasonably well completed in one year, but may continue for the full rotation. Compare the rotation system with the old one-crop system.

7. Replan a farm for greatest advantage for convenience of fields, shape of fields for plowing, advantage of stock water, etc. Change fences and roads where needed. The improvement in this project may be assessed by a committee visiting the place before and after.

8. Rent a farm to a tenant. Supervise the operations on the farm and keep books concerning these operations for a year.

9. In the community, find several farms which are rented to tenants on different plans of share renting or cash renting, as, with or without residences, with and without seed and fertilizer furnished, with and without running cattle on stalks and stubble-fields, after crops are harvested. Formulate plans for keeping records by which the profit to owners and to tenants can be determined in each of these plans. Compare these plans for one or for several years.

10. On a large farm or plantation, hire the labor for the place, keep time records, and pay the hands by the week or by the month. Plan and direct the work which these men are to perform. The profit from this project may come from the percentage allowed on the labor of the men, just as contractors are sometimes paid in other walks of life.

11. Maintain a livestock enterprise on a farm for a year, buying the necessary feeds or other supplies, selling products, keeping records, keeping up pedigrees and registration papers.

12. On a new farm, plan the proper location of the residence, yard, barn, well, fields, fences, roads, walks, etc. Work on the location of these and manage their construction for one year or more. In this project a time allowance may be made for the work done. The same percentage basis for supervision of construction may be fixed.

13. Select two farms with premises near together, as across the road from each other. Draw plans of these two premises showing location of all the important features of each. Keep records of the trips on both for a year in doing chores. Calculate the distance traveled by members of the family in drawing and carrying water, feeding stock, caring for machinery and tools. Then replan these places for better results and less labor in performing the chores. Calculate the saving for one year and let this be the amount of profit which the student has earned during this project. This may be paid by the owners.

14. A project similar to the above may be planned relating to the labor of plowing and cultivating fields of different shapes. It may also include the study of distances traveled going to and from fields of the farm for one year. In replanning, change the location and shapes of fields to obtain best results.

15. Keep records of cost accounting on two farms; one using a tractor for field work, the other using horses. Compare the results in the two cases. The economy shown should be the profit to the student in this project.

16. Plan the distribution of labor on a large farm for an entire year. Let the profit be calculated as in No. 10 above.

17. On two nearby farms, one having pure-bred stock, the other grades, compare the results for a year by accounting the cost and income. The profit in this project may be derived from the contrast shown.

18. Projects in different methods of marketing farm products may include contrasts of different ways, as with and without storage; wholesale and retail; with and without commission agents; with and without sorting or special packing. Selling products may also be compared with feeding them on the farm.

19. Formulate systems of advertising of special farm products; compare the different systems, such as newspaper advertising, bulletin boards, and circulars.

20. In the community, compare two or more farms for the purpose of contrasting diversified farming and specialized farming. Calculate profits of a year's undertaking on each type of farm.

21. A student in partnership with his father may take a project in managing the entire farm. This project may be restricted to only a part of the farm's enterprises: the livestock side or the crop production side. The management, however, is to be the important feature.

Projects in Farm Mechanics and Engineering.—So much of the work in farm mechanics is supplementary to other project work that it is somewhat difficult to plan profitable projects strictly in this field. In the following paragraphs a few kinds of mechanical projects are suggested:

1. Repair and take care of the machinery of the entire farm for one year. Let the cost of all repairs and work be charged to the farm at prevalent rates at machine shops.
2. Repair, maintain, and personally operate a farm tractor for one year. Do all the tractor work on the home place and, if possible, do custom work for neighbors. Let charges be made the same for the home place as for neighbors.
3. Erect a dairy barn and install the fixtures, hiring such help as may be necessary. Charge the farm for this work at prevalent rates for mechanical work.
4. Install a water-pressure system for the farm and its buildings. Operate and manage this for a period of one year. Let the work be charged at pipe-fitter's rates.
5. Install a lighting system for the farm buildings, including electric wiring, and charge the farm at the rate of electrician's rates.
6. Erect a permanent poultry house, with concrete floors, and make and install all appliances for a complete plant.
7. Erect a permanent swine house with concrete feeding floors. Make and install all appliances. This may include permanent yards and making of hurdle fences.
8. Make a complete system of concrete walks about the premises. This may include making articles of concrete needed on the farm.
9. On a large farm where there are many work animals a student may undertake to keep horses shod and in every way take care of their feet for a year, charging at blacksmith's rates.
10. A student may be the farm power expert for a year, repairing and maintaining tractors, automobiles, and stationary gas engines at mechanic's rates.
11. Improve the farm mechanically and keep records of the work, charging at proper rates for each line of work. This may include repairing of farm buildings, roofs, gutters; rebuilding or repairing fences; improving or perhaps relocating and building roads and walks; painting and whitewashing.
12. Let a capable student take full charge of the construction of a farm residence.
13. Manage the buying, improving, and selling of a farm for profit. This may be called a project in management as well as mechanics.
14. Install bathroom fixtures and make charge at plumber's rates.
15. Install a septic tank and connect bathroom and kitchen with same. Make charge at excavator's rates.
16. Survey and take levels, then install a land-drainage system by means of tiles for one or more fields. Charge at surveyor's and laborer's rates.
17. Make surveys and do leveling, and then construct terraces for one or more fields on the home farm or neighboring places. Make suitable charges for it.
18. Construct storehouse for fruit, and storage cellar for potato and root crops.

Relating Projects to School Studies.—The modern methods of teaching agriculture by project methods require that the work in

schools be correlated closely with the projects of the farm. In other words, the projects should parallel the work of the year in school. Much of the school time of the student is spent in the study of his home projects and the home projects of his classmates.

In this system a close parallelism is maintained between the work and the studies of the student. Because of this it is often desirable that the projects cover a period of about twelve months. At least the first twelve months of the work on any project should, if possible, parallel the studies of that year. If, however, conditions require it, the project work may continue for a much longer period of time.

As the subjects of the curriculum require the student to take up new topics, new projects should be undertaken and pursued in addition to those already in progress. It is thus evident that the student may be pursuing a number of projects at the same time.

It is by means of pursuing several projects that the student becomes a vocational agriculturist and is able to operate and manage the different enterprises of a farm.

School Management when Students are Pursuing Home Projects.—In many schools where vocational agriculture is taught and where students are expected to pursue home project work the principal of the school is not willing to make adjustments of the schedule from time to time to allow agricultural students time for pursuing their project work at home during rush seasons of the year—at planting time or at harvesting time. This difficulty is more serious with projects in crop production than with projects in animal husbandry.

Prospective pupils of agriculture in such schools will find it of great importance to win the coöperation of the principal of the school. In many other schools the teacher of agriculture is made the principal for the sake of making such adjustments of the daily program as are necessary from time to time to meet the exigencies of the work. In schools where the above mentioned difficulty exists some of the following suggestions may aid the instructor of agriculture to meet or avoid the conditions:

1. If possible, have students choose projects which require little absence from school—those which do not require the important steps to be taken during school hours. For example, Irish potatoes may be harvested slowly while sweet potatoes must be attended promptly when a killing frost comes. Market garden projects require special attention promptly at certain times, and the student must be absent to attend to them.

2. The teacher of agriculture must solve part of the trouble by planning

to have all of his class absent at the same time. This would mean that they should have projects alike or similar in requirements.

3. When the agricultural class is out of school have other students do supplementary work, as side reading, preparing essays, reports, looking up special references, making charts, drawing, preparing contest work, writing for newspapers, literary society work, projects of their own, as in home economics.

4. While agricultural students are absent they may make up class work or balance the work of other members of the class by preparing reports and essays on their home projects. These may be presented for credit in English classes.

5. Some teachers of agriculture plan to have the periods of absence brief and frequent rather than have prolonged periods. This plan also usually suits weather conditions better.

6. Try, if possible, to have the absent time of students fall on the hours or half days when the agricultural work is scheduled. Other class work is then uninterrupted. If roads are good, the students may return in time for their other classes.

EXERCISES

1. Collect a set of blanks for use in home project work. Secure these from your own state and several others. Study these blanks and make comparisons.
2. Write out fully the plans of a project with field crops.
3. The same for a project in animal husbandry.
4. The same for a project in gardening.
5. The same for a project in small fruits or orcharding.
6. The same for a project in farm management.
7. Visit projects of students of agriculture until you have seen the project work in all the above mentioned lines.
8. Make a list of things which a student should record in his notebook, while pursuing a project, in addition to the points covered by the state blanks.
9. Make a project score card for use of instructors in judging the project work of students.
10. Subdivide this score card to suit some particular kind of project with a field crop.
11. Conduct an exercise in taking students to see the project work of other students.
12. Compare each of the lists of projects suggested in this chapter and, in each list, select two which you think are better suited to your state or school than the others.
13. Formulate several questions for debate on "sizes of projects" in different lines of agriculture. Discuss these.
14. Make a list of the graduates and former students who are farming in the community where you are to teach or in some other.
15. Study the effects of the agricultural training which they received while in school or college.

QUESTIONS

1. Define what is meant by an agricultural project, and distinguish between that and an exercise, a practicum, or experiment.
2. Explain what is meant by major and minor projects.
3. What is meant by the scope of a project?
4. Who should agree to the project and its scope?
5. When should the plans of a project be made by students?
6. What is meant by a list of project operations?
7. Why should students make a study of the principles involved in each operation?

8. What advantage is there in his making definite citations to the topic studied or to be studied?
9. If there are no published outlines of a project to be pursued by a student, who should make the outline?
10. Why should a student keep a notebook while studying the topic?
11. How would you induce students to be systematic and careful in recording their project operations?
12. What observations should he be taught to record while pursuing his project? Illustrate.
13. Give a summary of a report on a project in crop production.
14. Mention the points in a summary of a livestock project.
15. Why should you induce all of your students to be uniform in the price allowed for feed and labor?
16. Mention the points to be covered in an analysis of the results of projects in crop production.
17. Mention the points to be covered in an analysis of the results of a project with livestock.
18. What points should be included in a set of record forms?
19. What are the essentials of a milk and butter record form?
20. Under what conditions is it important to keep records of the weight of animals?
21. What poultry record blanks are necessary?
22. Why should the student record the use of farm implements in his project work?
23. State the purposes of the visits to projects by instructors.
24. What should be the attitude of the instructor when visiting projects?
25. State the instructor's relation to notebook and record keeping.
26. Why should he give both written and oral instruction in visiting projects?
27. What is the value of a project score card?
28. What two kinds of factors are to be judged when using such a score card?
29. State how you will probably travel in visiting the project work in the vicinity of your school.
30. What can you say on the importance of good roads in conducting project work?
31. Why should the students be taken to see the work of others?
32. Suggest projects with field crops.
33. Mention eight or more projects with dairy cattle.
34. The same with soil improvement.
35. Give a good list of projects with hogs.
36. Mention several projects with beef cattle.
37. Give nine or more projects in sheep raising.
38. Mention six or more projects with horses and mules.
39. Give a good list of poultry projects.
40. Give a list of vegetable garden projects.
41. Mention five kinds of projects with small fruits.
42. How can home projects in orcharding be confined to one or two years?
43. Would you advise the use of nursery projects? Mention several.
44. Why would you encourage the pursuit of projects in landscape gardening? Suggest several.
45. Enumerate several projects in farm management.
46. The same in farm mechanics and engineering.
47. Why should the project work be closely related to the school studies?
48. Give your views regarding school management when students may be away pursuing home projects.

CHAPTER XIV

HOW TO USE A LAND LABORATORY

Land Laboratory a Need.—Objective teaching is essential in an applied science such as agriculture. The laboratory method is a necessary adjunct of the teaching of agriculture whether conducted in the rural school, the grades of the town school, the high school, or the college. Much laboratory work can be done in the rooms of the school building, either those devoted to agriculture or to the general sciences. But agricultural principles and processes that deal with the outdoor life on the farm need for their proper comprehension and practice an outdoor working place for the pupils. This may be either the home farm of the pupil or the land laboratory of the school.

Such a land laboratory is just as important for the pupils in agriculture as is an indoor laboratory for those who study chemistry or physics. It has an important part to perform in the teaching of agriculture which must be performed if the teaching is to be fully successful and which cannot be performed by any other means. Valuable as are the textbook, the library, the indoor laboratory, and the home farm, there are certain essentials which cannot be supplied by any or all of them. The land laboratory is not in conflict with any of them, but is supplemental to each. It is not a substitute for any of them, nor can any of them nor all of them combined be a substitute for it.

Characteristics of the Land Laboratory.—The land laboratory should be from one quarter acre to one acre, in addition to the ornamental campus and playgrounds, where facilities for its proper care and use are limited. This may be expanded to two or three acres or more where certain larger uses (mentioned later) are to be made of it and where labor and funds for the large area are available.

It should be near the school building, the nearer the better, since it is a school laboratory and not a "model farm," an "experiment farm," a "demonstration farm," or any other kind of a "farm." The agriculture class should be able to reach it, perform their work, and return to the school in the regular allotment of time provided in the school program and not encroach upon the

time of the preceding or the following recitations. The possibility of accomplishing this easily is necessary if the land laboratory is to attain its fullest usefulness as a factor in the successful teaching of agriculture.

The contour and the soil should be superior and should be sufficiently uniform to permit the lay-out to be determined solely by the needs of the school. Since it is not to be a "farm" there is no necessity for it to be "typical" of the local farms. A degree of

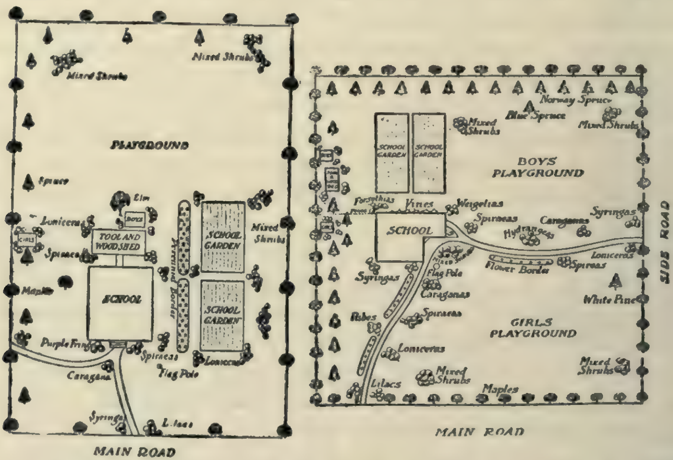

FIG. 154.—Plans for improved rural school grounds of about two acres or less, showing areas for gardens and play. (Arkansas Department of Public Instruction and U. S. Bureau of Education.)

similarity would be advantageous if there were special need for illustrating local adaptability of crops.

The land laboratory should be upon land which could be controlled by the school authorities for a term of years in order that plans once established shall not be disturbed. This is best accomplished by the school owning the land, but if this is not practical it should be held under a long time lease.

Plans.—After a careful study of the curriculum in agriculture the land laboratory should be carefully planned to meet its needs for years ahead so far as they can be foreseen. Blue prints should be made of these tentative plans and filed with the principal or superintendent and the officers of the board. A copy should be framed and hung in the school. These plans should be general and should set aside space for the perennial crops, preferably along the

borders; for poultry, if it is to be kept; and a large space reserved for annual use. Plans for the use of the annual portion should be made each year, blue printed and filed as suggested above. The different portions of the grounds should be suitably separated by walks and marked by neatly painted stake signs. The different plants and crops should be neatly labeled (Fig. 154). Explanatory signs should be erected which are sufficiently explicit that pupils and visitors may understand what is seen and may learn much from mere observation.

Upkeep.—At all times every portion of the land laboratory should be properly fertilized, well cultivated, tidy, orderly, and

Fig. 155.—A good method of marking the land laboratory enterprises is shown in this demonstration of cover crop on school land laboratory in California. (H. I. Schnabel.)

free from weeds, and rubbish (Fig. 156). The land laboratory is intended to be a factor in teaching, and as such it is quite certain to perform its function. Whether what it teaches is the best or only the indifferently good or even the really worst is for the person in charge to determine by the wisdom and skill with which he handles the land laboratory.

Uses, General.—The land laboratory is used to objectify principles and to illustrate certain processes that cannot be fully understood except by actual performance. Its principal purpose is to serve as a means of teaching the pupils of the agriculture classes in the school (Fig. 156). Its use as an extension factor in teaching the out-of-school population is wholly secondary. It may also be used to supply in part the lack of certain previous, practical,

concrete experiences of pupils and also to provide new concrete experiences during the course of school instruction which it is impractical to obtain at the time from the farms. It is also to furnish opportunities for observation of agricultural conditions which are valuable in the learning process, but which, because of the difficulty of taking pupils to local farms, would not be done

FIG. 156.—Students should be taught the horticultural skills and many others on the school land. (R. S. Mackintosh.)

at the right time or not done at all. It also makes it possible for the teacher of agriculture to control the time and conditions so his pupils will be enabled to see what they need to see and at the time they need to see it. It is preëminently adapted to group teaching, in which it excels the indoor laboratory work. In a school period an entire class can be taught how to perform some process, such, for example, as transplanting tomato plants, and can be given actual practice in doing it under guidance and criticism and thus prepare for their home project work.

It is especially valuable in influencing the choice of the sequence

of the topics in the curriculum and in vitalizing the teaching when this sequence is pursued. The teacher with foresight can by the use of the land laboratory objectify the most important portions of his agriculture work, so far as it deals with plant industry, at the exact time the pupils are interested in any particular topic.

It also furnishes the best possible opportunity for the use of the problem method of study and teaching.

A problem of seed or soil, or planting or cultivating, or care or harvesting is imminent, and after finding from the library the standards proposed by others for its solution the class may discuss the procedure and then proceed to its actual solution in the land laboratory.

It does not remove the necessity for trips to observe conditions and procedure, nor does it in any manner take the place of demonstrations on local farms for the community benefit, nor of the home project work of the pupil. Observations on farms are necessary where actual farm conditions and actual farm procedure on a practical farming scale are to be comprehended by the pupils; but there are many principles and smaller practices which the pupils need to have made objective to them when a trip is impracticable and for which the teacher needs to have the conditions under his own control. These belong on the land laboratory of the school.

Demonstrations intended for the observation of practical farming with the purpose of improving the farm practices of the neighborhood through imitation should be placed on a local farm well situated for easy inspection. There is little use for them on the land laboratory of the school excepting, possibly, in a new country where the farmers are not yet prepared to take charge of them. There is no reason why even those placed on the farmer's farm should not be under the auspices of the school, but the conditions of soil, care and management should be met as they would be on a regular farm.

If the pupil is to conduct a project consisting of a definite farm management unit with financial profit as one of the factors, it should be on the home farm or a similar portion of land which is under the control of the pupil, and not on the land laboratory. The home project specializes upon one thing while the land laboratory deals with fundamental facts, principles, and processes which the pupil needs to know in order that he may apply them to any one of many projects. This objectifying of underlying, essential

truths applicable to farming operations distinguishes the land laboratory from the home project, which aims at the actual performance of some one related series of farm operations under practical farm conditions for the rewards usually expected to follow such performance. For this reason the land laboratory is indispensable for good agriculture work in the elementary grades and the high school regardless of the amount of emphasis which may be laid upon the field trips, farm demonstrations, or home projects. Far from detracting from any of the others, it prepares the pupil to reap a larger benefit from them.

Uses, Specific.—The manifold difficulties attending the equipping and operating of a school "farm" make it necessary that the

Fig. 157.

Fig. 158.

Fig. 157.—Among other things to teach on the land laboratory is the field selection of seeds. These students are selecting cotton for seed. See directions in agronomy chapter. (G. R. Ransom, Okla.)

Fig. 158.—On the school land teach the methods of de-tasseling barren stalks and alternate rows of corn.

land laboratory shall be small, that animal study (excepting such small animals as poultry) be excluded, and that it be used primarily as a feature of the regular school agricultural work and only secondarily as a feature of the extension work of the agricultural department. Its greatest usefulness will be in the subjects of farm crops, horticulture, soils, and poultry.

In farm crops, methods of seed selection (Figs. 157 and 158), breeding, harvesting, grading, storing, and testing may be studied and practiced, each new class inheriting in the fall the crops planted by their predecessors in the spring and in like manner leaving an inheritance to their successors of the next year. Frequently the classes can be combined for the fall work. In this way the "ear

to row" test of corn; the "bin" selection, tuber unit, followed by the "hill" selection of potatoes, and similar processes may be conducted.

Plant studies such as foliage, stalk, and fruit characteristics; root distribution; disease resistance; yield in relation to seed character-

FIG. 159.

FIG. 160.

FIG. 159.—Students learning to save money by making their own lime-sulfur on the land laboratory instead of buying it already prepared. (Joelton, Tenn.)

FIG. 160.—Spraying school trees with same material to kill San José scale. (Horace McMurtry.)

FIG. 161.—Top working of fruit trees by students, Ontario, Calif. Sufficient trees may be grown on a half acre to furnish the school orchard practice for a class. The community and home project work will give more. (Chas. J. Booth.)

istics, soil preparation, and methods of cultivation; diseases and pests and their treatment can be easily adapted to class work (Figs. 159 and 160). The various processes of plant propagation, pruning, trimming, and care (Fig. 161); processes of soil preparation; processes of seed testing and preparation, such as potato cutting, may be illustrated

to entire classes. Some of these exercises lend themselves well to demonstrations on the local farms if suitable ones are available.

Crops unfamiliar to pupils and not easily available for study in the neighborhood may be produced on the land laboratory and studied as they grow. New varieties may be treated in the same manner, though when it is deemed advisable to test varieties for the purpose of discovering their adaptation to local use it should be done in a regular way on a local farm. Grains, legumes, forage crops, tubers, roots, and small fruits may thus be introduced on

FIG. 162.—While the land laboratory may contain a typical home garden for teaching purposes, the gardens of the pupils should be on the home ground whenever possible, as is that of the school girl shown above. (W. V. Longley.)

the land laboratory of the school and the better varieties developed later on the local farms.

Another justifiable use of the land laboratory is for the raising of supplies for use in the indoor laboratory. Much of the needed indoor laboratory material may be obtained only from surrounding farms, but there is a great deal needed which can be obtained by raising it. This plan has the advantage that the school is able to obtain specimens at the various stages of growth and to preserve them in that stage for future study, besides the obvious one of studying the process of growth in the live plant which is impractical if trips must be made to local farms for that purpose.

In producing laboratory supplies it is not advisable to raise each

year a small supply of everything needed the next year, but a large enough quantity of one kind should be raised one year to last several years, a several years' supply of some other things being raised each succeeding year. Such supplies must be carefully prepared for stor-

Fig. 163.—This ten-acre land laboratory at the high school, Bemidji, Minnesota, with the use of the land of the adjoining fair grounds, enabled the school to render invaluable benefits to the students and to the pioneer farmers of this new part of the state.

Fig. 164.—A "close up" view of a small portion of above farm devoted to instructing the younger pupils in gardening. (B. M. Gile.)

age and placed where they are safe from vermin, light, heat, cold, or moisture according to their characteristics. There are many bulletins giving specific instructions on how to prepare and preserve them.

While vegetable gardens of individual pupils are better upon the home grounds (Fig. 162) or vacant land near the home, one of the most valuable uses of the school land laboratory is to maintain a typical family vegetable garden (Figs. 163 and 164). Few

families know how to plan and care for a good vegetable garden and still fewer do so. Such a garden on the land laboratory should be a class problem so all pupils may become familiar with all the features of it. The class should plan, select seeds, plant, and care

Fig. 165.—This general view of the land laboratory at Sleepy Eye High School shows horticulture and landscape work in the foreground and many field crop enterprises of the agriculture work in agronomy beyond. (J. A. Cederstrom.)

for the garden. Such a garden should be arranged to economize man labor and use horse labor to the greatest possible extent. The plan should provide for the replacement of certain crops by later ones, for perennials such as asparagus, for small fruits, and

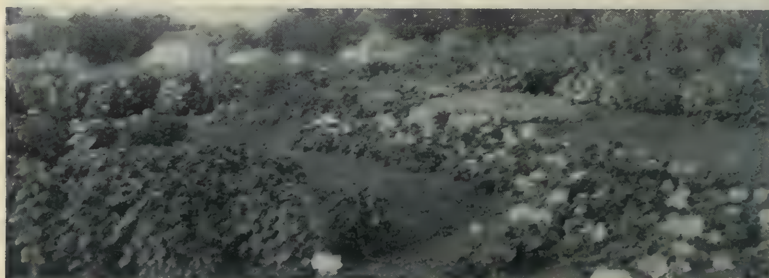

Fig. 166.—A "close up" of a corner of the same land laboratory. (J. A. Cederstrom.)

for all vegetables adapted to local conditions in quantities suitable for the typical family. Economic and efficient cultivation, harvesting, and storage should be taught. The preparation and care of this garden will furnish the opportunity of instructing in a group the entire class preparatory to their taking the same steps in their home gardens (Figs. 165, 166, and 167), thereby saving much time of the instructor that would otherwise need to be spent in trips to

individual gardens and many failures of pupils from attempting the process without sufficient previous instruction accompanied with practice. The produce from this typical garden can be sold as harvested or the home economics class, if there be one, can put it in containers and sell it in that form, the proceeds to be devoted to some justifiable school use.

The ornamental campus of the school, the grounds of the teacherage, the playgrounds, and the land laboratory can be utilized in performing many of the enterprises suggested in the chapters

Fig. 167.—A small portion of the land laboratory may be used to instruct pupils in gardening methods so they can succeed better in their home gardens. (A. J. Secor.)

on horticulture, farm mechanics, and projects. In addition to teaching the specific processes involved, this will cultivate an interest and pride in the school and its property.

Equipment.—On a small school "farm," equipment is a serious item because of the initial expense and the continuously high overhead. Even on a large land laboratory the equipment is small, inexpensive, and relatively economical. If there is a suitable storage space in the school building and the land laboratory is sufficiently near, no building is necessary unless chickens or other small animals are to be kept. If tools, seed, and the small machines cannot be stored in the school building, a plain substantial building will be needed for that purpose on the land laboratory. The space therein should be carefully allotted to the different articles stored there and everything should be kept in its place. Habituate the pupils to having "a place for everything and everything in its place."

The schools should not own the horse-drawn machines, but

should hire horses, men and machines when such work is to be done. Some of the smaller machines driven by internal combustion engines [1] may be utilized to good advantage. There should be a supply of whatever tools are necessary to perform the work required by the curriculum. Those that are to be used by pupils should be in sufficient numbers that all may keep employed. Hotbeds, coldframes, lath houses, and whatever similar equipment the climate requires should be provided. If a greenhouse is not provided at the schoolhouse (the better plan Fig. 168), one may be erected elsewhere on the land. In most localities it will be advis-

Fig. 168.—Interior view of greenhouse in Massachusetts. Students may use such a house for early plant production, and the young plants may be sold in the market or transplanted to the school land. Such a greenhouse should be connected with the main building if possible. (E. H. Scott.)

able to have the laboratory well fenced with woven wire high enough to prevent entrance except at the gate, which it may be necessary to keep locked at night and when the laboratory is not in charge of some one. All equipment should be the property of the school and should be carefully inventoried and the inventory checked twice a year.

Care of the Land Laboratory.—The land laboratory should be in the direct charge of the teacher of agriculture. Sufficient funds should be set aside for its successful operation. All work not furnishing definite educational returns to the worker should be paid for from this fund in the employment of laborers, preference being given to competent agricultural students. Work which

[1] *E.g.*, the various garden tractors.

pupils are required to do as a part of their educational activities should not be paid for any more than should laboratory work in chemistry or physics. Care must be taken that exact justice is done in this matter.

While the agriculture teacher should not hesitate to don his

Fig. 169.

Fig. 170.

Fig. 169.—Students working at twenty-five cents per hour with hoes in cabbage field. Fig. 170.—Three-acre truck garden where students work on the profit-sharing basis. (T. G. Brown.)

working clothes and do anything necessary for the success of the educational work in this laboratory, or in an emergency to perform the non-educational work, the school cannot afford to have him

Fig. 171.—The school land may be used to grow plants to be sold for beautifying homes and schools. (J. A. Cederstrom.)

neglect more important duties in order to perform the unskilled labor which can be procured at much less expense (Figs. 169 and 170).

How to Make the Land Laboratory Pay.—The land laboratory is a teaching enterprise and not a farming enterprise. Like the class-room, the library, the chemical laboratory, and the physical

laboratory of the school, its purpose is to spend money wisely for the education of the pupils and not to make money for the school treasury. It should be made to pay a profit, but the profit should be calculated in terms of knowledge and wisdom, not in dollars and cents. The first aim should be to produce the largest educational return to the boys and girls. If in the legitimate pursuit of this aim and without hampering educational efficiency some money income can be produced to aid in reducing the cost, it should be welcomed (Fig. 171); but under no circumstances should the desire for a money income from the land laboratory be the cause of lessening in any way the efforts for the greatest possible educational results. Indeed, if the cash income from a land laboratory (not a farm) were greater than the cash outlay, it should prompt a careful inquiry into the character and quality of the teaching of agriculture in that school.

Problems of a Large School Farm.—Experience is rapidly demonstrating that for regular elementary and secondary schools the use of land should be limited to an area no larger than is necessary to serve the need of a land laboratory as set forth in the preceding pages of this chapter. Special types of schools or unusual economic, sociological, or agricultural conditions may make advisable the use of a regular farm under the control of the school. If this is done, the principal problems confronting those in charge will not be those of the use of the land laboratory as an adjunct in the teaching of agriculture to the students of the school but will be that of making practical the operation of a farm by an institution instead of by an individual.

In so far as the farm is used as an aid to teaching, the contents of the foregoing pages in this chapter will be of assistance. To overcome some of the difficulties arising from its being a *farm* instead of a *laboratory* the following condensed suggestions may be helpful.

1. The principal difficulties arise from the following conditions: (*a*) The farm being either too small to be an economical farm management unit or too large to receive the proper attention of those in charge of the school; (*b*) containing too many endeavors to be financially profitable or too few to be educationally efficient; (*c*) possessing too much capital for the educational return received or too little for full success as a money making enterprise; (*d*) having too many heads, such as presidents, principals, boards, committees, teachers, and foremen, to be successful either educationally or financially; (*e*) too much fault-finding and diversity of opinion and too little encouragement and approval; (*f*) too limited markets for products most advantageously raised on an institutional farm; (*g*) too difficult to coördinate the interest of the student with the necessary routine of a practical farm; (*h*) too difficult to demonstrate scientific processes, obtain the active interest of the farmer, and produce a profit in the same operation; (*i*) too many changes of agriculture teachers resulting in (*j*) too limited a mastery of the community situation by the school.

2. All practical work which is distinctly educational should be performed by students without pay working under a competent foreman or instructor.

3. Much of the labor on large farms should be performed by students pursuing school farm projects (Fig. 170).

4. Certain areas on the farm should be apportioned among the students

pursuing projects. Even the livestock of the farm may be apportioned among the students for project purposes.

5. All routine, non-educational work on the farm not performed in the pursuit of projects should be paid for by the school farm, preference being given to students in employing this kind of labor.

6. As foremen, superior students are to be preferred above unintelligent workmen.

7. Let the products of the school farm projects and the other products of the school farm be sold at dining halls and elsewhere at regular market prices.

8. Train students in salesmanship, in coöperation, and in studying marketing conditions through marketing their own products.

9. Stalls for the sale of school farm products may be established by students along the roadside or in city centers. Superior business methods should be used in preparing products for market, advertising, and conducting the marketing enterprise.

10. Remember that one of the chief values of the large school farm is its influence upon the community.

EXERCISES AND QUESTIONS

1. State the size of any land laboratories with which you are familiar and tell what you know of the effect of the size upon the educational results.

2. Give the distances of any such land laboratory from the school building, the length of time it takes a class to go between them, and the effects upon the work of the school.

3. What are the advantages and disadvantages of the school district owning the land for the laboratory? Leasing it?

4. Make a drawing showing a desirable general plan for a land laboratory in your locality. Show relative dimensions and location of small fruits, trees, shrubs, annuals.

5. Give the wording of explanatory signs that you would expect to see in a land laboratory.

6. Describe a land laboratory you have seen. What did you learn that you were prompted to emulate? To avoid?

7. What are the principal objections to the use of the land laboratory as an extension enterprise?

8. Illustrate how the land laboratory might supply the pupil with a valuable experience which he lacked.

9. How it might save many trips to farms.

10. Relate a few specific ways in which the teacher can use the land laboratory advantageously for group instruction.

11. State five provisions the school may make on the land laboratory in the spring for valuable lessons to be learned in the fall.

12. State five problems of interest to pupils that can be solved by the use of the land laboratory.

13. Discriminate between the use of the land laboratory and observation trips to the farms; demonstration work on farms; home project work.

14. Name three demonstrations best adapted to use on regular farms.

15. State definitely five crop projects suitable for home work on *farms* in your locality.

16. Show how the pupil's work on the land laboratory may fit him for more successful project work.

17. Name ten specific things that would be suitable for placing on the land laboratory of the school.

18. Do you know of any crops, or varieties, or processes that have entered your neighborhood by way of the land laboratory of the school?

19. Make a list of ten things needed for indoor laboratory work that should be produced on the land laboratory.

20. Which of these could be perserved for three years? How?

21. Draw a plan of a family vegetable garden suitable for your neighborhood, showing the location and arrangement of vegetables.

22. Make a list of the vegetables that such a garden should contain, the amount of each that should be produced, and the space required to raise each amount.

23. Draw a plan to scale that will produce the results projected in exercise 22.

24. Make a list of the quantity of each kind of seed needed and the cost.

25. If the garden products are put up by the home economics class and sold, how should the proceeds be apportioned between agriculture and home economics?

26. Make a list of small machines that should be owned by the school for a land laboratory at your school, including prices.

27. Make a list of tools the teacher will need for his work.

28. Make a list of tools pupils will need, and the cost of enough to supply a class of ten.

29. Select a kind of woven-wire fencing for a land laboratory and give reasons for your choice. Determine the entire cost of buying and erecting such a fence.

30. What are some of the things the agriculture teacher should do himself on the land laboratory? Why?

31. What should he hire done? Why?

32. Why do some people expect the school land laboratory to pay a money profit?

33. Is it advisable for a public school to run a farm? Why?

34. Can a piece of school land from one-tenth to one-twentieth the size of a local farm be successful as a "model farm"? Why?

35. Name some things that might be a source of income to the school land laboratory without detracting from its educational efficiency.

REFERENCES

"Division of Agricultural Education," University of Minnesota, St. Paul, Minn., Master's Thesis. (W. F. Lusk.)

Hummell, W. G. and Bertha R.: "Materials and Methods in High-School Agriculture."

Hummell, W. G.: "Utilization of Land by High Schools Teaching Agriculture."

Nolan, Aretas W.: "The Teaching of Agriculture."

Stimson, Rufus W.: "Vocational Agricultural Education."

Storm, A. V.: "The Teaching of Agriculture."

Merritt, Eugene: "Use of Land in Teaching Agriculture in Secondary Schools," U. S. D. A. Bulletin 213, 1915.

CHAPTER XV

HOW TO EQUIP FOR TEACHING AGRICULTURE

ROOMS AND FURNITURE

It is the business of the officers of organization and administration to furnish the rooms and the equipment. It is the business of the teacher of agriculture to know what is needed and how it can be obtained and to urge the necessity upon them. The number and size of rooms and the amount and kind of equipment will depend upon the curriculum to be taught, the numbers and grades of students to take agriculture, the extent to which the agriculture department is to become a service center to the agricultural community, and the money available. The idea, somewhat prevalent, that agriculture can be taught with no equipment and no expense is misleading. To be sure the subject is so rich in interest-creating content and so much illustrative material can be obtained from nearby farms that very valuable work can be done with very little cash outlay. This is true of physics, chemistry, and biology. But if really worth-while work is to be done, suitable rooms and equipment must be provided and money expended. If all needed equipment were to be owned by the school, agriculture would be quite expensive; but some, such as animals and machinery, can be borrowed from members of the community; others, such as test tubes and racks, ring stands, microscopes, dissecting needles and forceps, can be used in common with the science departments, while others that do not need great refinement or precision may be made in the shops of the school or by local workmen. Even with these plans well executed to their limits there will be much to purchase if the agriculture is to be well taught.

Rooms.—If the needs of the school and the community were sufficient to warrant it, an agriculture department in a secondary school could use the following rooms:

A recitation room, a laboratory adjacent, a dairy room, a combined livestock-judging, rough-work and machinery room, a storeroom, a greenhouse, and a dark room. Few high schools with one agriculture teacher would attempt so elaborate a plan.

A more practical arrangement for the high school of average size serving an agricultural community is a condensation and modification of this list. The laboratory and recitation work

would be done in one room with the furniture arranged as stated later. The work connected with dairy products that is practiced on the ordinary farm, such as milk and cream testing and cream

Fig. 172.—A small greenhouse is helpful in teaching agriculture during the long winters of the northern states. When suitable materials are purchased, students can erect such a house. (A. A. Sather, N. Dak., and R. A. Mooney, N. H.)

separating, can be performed in the recitation-laboratory room.

The greenhouse is valuable in freezing latitudes, but can be used jointly by agriculture, botany, and other departments of the school (Fig. 172).

The dark room is not a necessity but is very valuable, not only for the agriculture but for other departments and could be used by all. It need not be large and may be in the interior of the building, and as it needs very little furnishing except running water and a sink it need not be expensive.

Storage space is essential. It may be, if necessary, space ill-adapted to class-room work, but should be dry, light enough to properly obtain and replace things, and convenient to the recitation room.

If the gymnasium is in the basement or on the ground floor,

Fig. 173.—By the use of plenty of sawdust and some home-made "bleachers," this school converted this space into a serviceable stock-judging room for the farmers' short course.

accessible from outside through wide, high doors, it can be utilized for machinery work and stock judging by using a loose false floor or plenty of sawdust or similar covering (Fig. 173).

By this arrangement the agriculture department occupies only one room suitable for regular class work of the schools, the other rooms being either inexpensive space not otherwise usable, or rooms used in conjunction with other activities of the school. If the recitation room and storage room are to be newly constructed, they should be made mouse-proof by concrete and woven wire construction. If rooms already constructed are to be used, they should be proofed as well as possible by use of these materials.

The agriculture room should not be used for other purposes. The large amount of special equipment and supplies and the neces-

sity of keeping some of it in active duty from one day to the next make it difficult to use the room for other purposes without either causing much extra labor in caring for important and often expensive equipment or risking inconvenience and loss through the presence of other classes.

In addition to these rooms, a room for the farm shop work should be provided (Fig. 174) unless the school has provided suitable room and equipment for its mechanic arts classes, in which case they may be used for instruction in farm mechanics (Fig. 175).

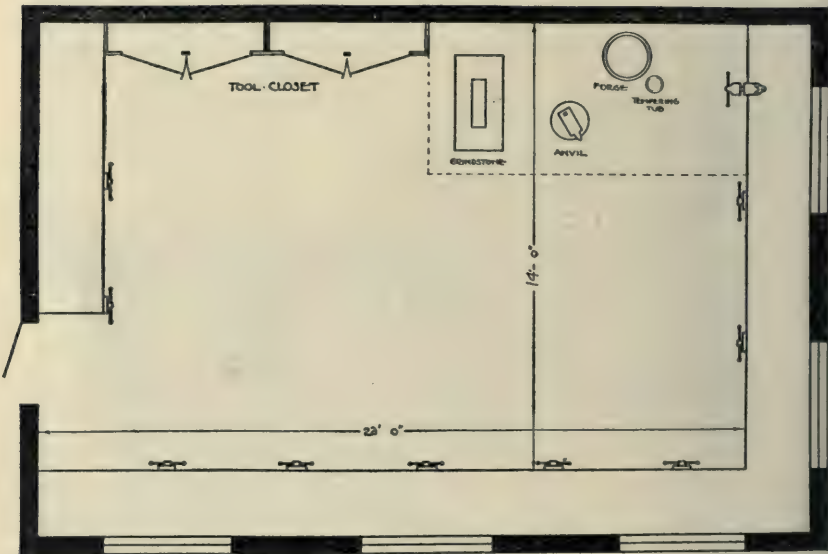

FIG. 174.—Plan of room for farm shop work at the school. (Bulletin, University of State of N. Y.)

Fixtures.—The main agriculture room, the recitation-laboratory (Fig. 176), should have the general characteristics of any class-room and if possible be accessible from the outside so that farmers may enter without the embarrassment of traveling the school corridors. It should have electrical connection in the wall near the proper location of the stereopticon and reflectoscope. A sink with work table, running water, and waste pipe should be at the side of the room where it is light. Gas connection near the work table with a plate for heating water is convenient. Slate blackboard of maximum width at the front and the interior side of the room,

with additional sliding blackboard at the front, are needed. Molding should extend around the entire room for suspending pictures, charts, and certain apparatus, such as some types of seed-corn racks. Windows should be provided with close-fitting dark shades to darken the room for the use of the stereopticon and opaque projection. Folding display racks should be attached to the wall at the front of the room. If a motion picture machine is to be used in this room, a platform, perhaps movable, in the rear of the room to elevate the machine above the heads of the audience should be

FIG. 175.—Shop and articles, including benches, made by students in vocational agriculture, at Lamar, Ark. Equipment for teaching farm shop work need not be expensive. (M. R. Ensign.)

provided and such a booth as insurance rules and the kind of machine and film require. It is probably better to have the motion picture machine placed in the assembly room or other large room of the school and to take the agriculture classes there for any agricultural films that are used.

A *good* screen for slides and reflectoscope work should be mounted on a spring roller over the blackboard at the front of the room.

Cupboards, display cases, and similar equipment may be a part of the fixtures by being attached permanently to the walls, but as changing the agriculture work to other quarters is always a possibility, as also is salvaging in case of fire, it is a wise precaution to provide them as furniture rather than fixtures.

The storage room should have open shelves for general supplies; locked cupboards for those requiring greater care; vermin-proof containers for such supplies as attract vermin; racks for such things

FIG. 176.—Back and front of main agricultural room, Stanley, Wisconsin. The cases at the left are convenient, but should be protected from dust.

as corn trays (unless they are provided in the recitation room); hooks for such things as can be so stored; and open floor space for such apparatus as trap nests, cream separators, and seed-corn graders when not in use. The room should be well locked, with

keys for the teacher, the custodian of the building, and the executive officer of the school.

The dark-room should have running water and waste-pipe connections, sink, light (electric preferred) with ruby protection and ruby windows, and should be light tight.

The greenhouse should be so placed as to be in the sun all day and easily accessible from the agriculture and the botany rooms.

If the gymnasium is to be used for stock judging or farmers' week meetings, extra bleachers may be provided, so constructed that they can be taken apart and removed to be stored when not

Fig. 177.—This combined assembly room, stock pavilion, display room, and gymnasium is worth thoughtful consideration by schools able to erect and to use to advantage a building of its dimensions and cost. (H. N. Loomis.) (See text.)

in use. A gangplank, smooth on one side for machinery and cleated on the other for livestock, should be provided. Little else is necessary for fixtures in this room.[1]

Furniture.—The teacher should have a combined desk and demonstration table, with plenty of drawers and a stain-proof and mar-proof top, and large enough to provide space for any desired demonstration.

There are two good plans for combining the recitation and laboratory work in one room. The students may be provided with flat-top working tables, narrow and long, accommodating two

[1] Smith Agricultural School, Northampton, Mass., has a combined stock pavilion, assembly room, and display room which is worthy of study if so elaborate an arrangement is desired (Fig. 177).

pupils sitting side by side and both facing the front of the room (Fig. 178). Directly under the table top are three shallow drawers. Under the middle drawer is another drawer, and under this a large cupboard for larger articles to be used in common. The drawers are fitted with master-keyed locks. Small, closely constructed

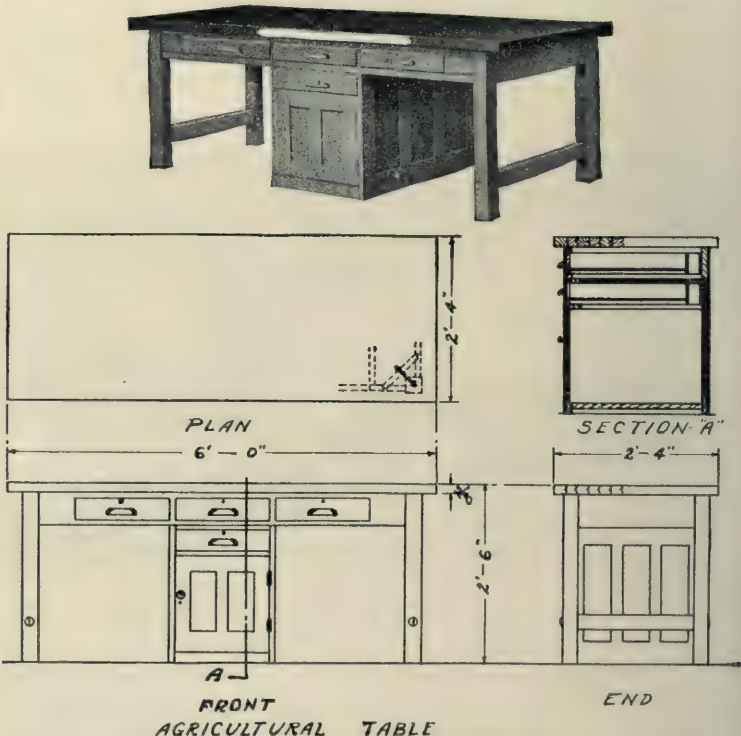

Fig. 178.—Photograph and working drawing of agriculture-laboratory table described in the text. This is a modification by A. M. Field and J. V. Ankeney of a biology table made by the Kewaunee Mfg. Co., Kewaunee, Wisconsin.

chairs without arms are used. Tables and chairs are loose from the floor. All pupils sit facing the teacher's desk (or any other point desired), no pupil is facing another, each has working space, writing space, and drawer space available at any moment without the confusion of moving.

With this arrangement any portion or portions of any recitation may be devoted to any method of instruction, quiz, examination, lecture, laboratory, conversation, demonstration, or a combination

of any or all of them without loss of time or attention and with the best possible conditions surrounding the pupil and the teacher for each method.

Such a pupils' work table was designed by the faculty of the Division of Agricultural Education of the University of Minnesota

FIG. 179.—Front and rear of main agricultural room, Cleveland, Tennessee, showing type of chairs, wall charts, teaching materials, apparatus case, and bookcase. (Jas. T. Lovell.)

and manufactured for them by the Kewaunee Manufacturing Company, Kewaunee, Wisconsin. Compare with figure 180, where the pupils face both ends of the room.

Another plan, though not so desirable, is to have the pupils' chairs, preferably with writing arms (Fig. 179), compactly arranged near the teacher's desk and facing it, with work tables back of them

seated with small chairs without writing arms. When pupils are engaged in laboratory work they are seated at the work tables, and when reciting, in the chairs near the teacher's desk.

Fig. 180.—Plenty of table and work-shelf surface is desirable, as is also a good glass-front cabinet filled with supplies for laboratory. For better style of tables and arrangement of class, see text. (S. R. S., U. S. D. A.)

Fig. 181.—Two types of glass-front cabinets designed by an agriculture instructor. The sliding-door plan was adopted after experience with the swinging doors. The cups were won in judging by the school pupils. (W. V. Longley.)

As the best teaching procedure in secondary schools is to utilize during the class period any "method" or combination of methods which the character of the subject matter or state of mind of pupil or pupils makes advisable instead of a "lecture" or recitation on Monday and a "laboratory" on Wednesday regardless of the sub-

ject sequence of pupils' needs, the furniture and the room arrangement ought to provide for this procedure with the least waste of time and effort. Both of the above plans are adapted to this procedure, though the former is plainly the better. The most common arrangement fails to meet these requirements (Figs. 176 and 180).

If the teacher is to use a combination of methods, he must have readily accessible those supplies for which there is a probability he will have need at class time. For this purpose, near his desk,

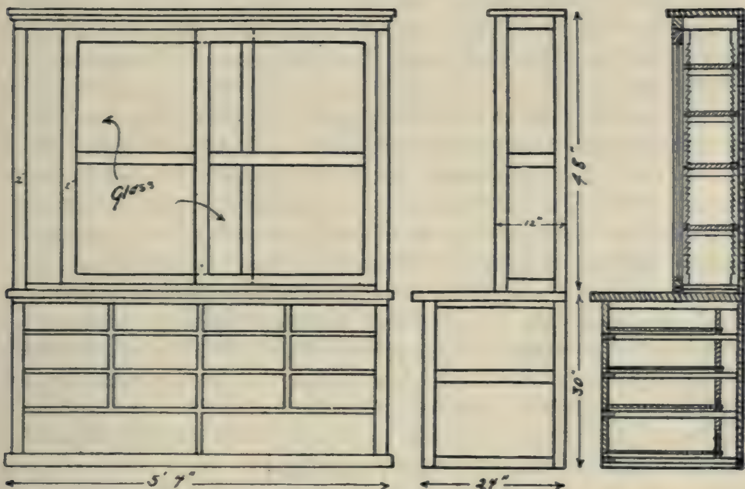

FIG. 182.—A cabinet for agriculture rooms. The cupboard top is free from the base. It is fitted with sliding doors having ball-bearing sheaves and track. One door is fitted with an Eagle No. 2001 combination lock; the other, with either lock or a common cupboard catch. The drawers have projected chamfered fronts, tight bottoms, and are locked by an automatic locking device controlled by the two middle drawers of the top row, which are in turn locked by combination locks. The drawers should be fitted with card frames or holders and pulls or card-holder pulls. The top may be built up of birch or some soft wood. The strips should be doweled and glued, with grain opposed. The top should be attached to the base with wood buttons and screws to provide for expansion and contraction. Top of base should have acid-proof finish. The remainder of the case may be stained and oiled, or stained, shellacked, and waxed. (Ankeney and Field.)

there should be a wall cabinet with sliding glass doors above and various sizes of drawers (and a door opening to shelves) below (Figs. 181 and 182). With these spaces varied in size he can have what he needs, in good order and ready for use.

In schools where a large amount of time is expended on something of large local interest, such as corn in the corn-belt regions, a special cabinet built to receive the trays upon which a five or ten ear sample is placed may be provided. The trays should be

adapted to the size of the pupils' work tables and the cabinet to the trays. The cabinet should be vermin-proof.

In addition to the direct teaching done by the instructor, pupils learn much from their surroundings in moments of comparative leisure. To utilize this, as well as to have available for regular class use many helpful articles, wall space not otherwise used ought to be occupied by display cases with glass doors and by pictures and charts. These should be changed from time to time to conform to the character of the class work. Typical and superior specimens of grains during the work on cereals; grasses and hays during the study of forage crops; pictures of horses, cattle, sheep, swine, and poultry, while each kind of animal is being studied, will increase the interest and comprehension of the students. The parts of such cases too low for display purposes can be utilized for the storage of materials frequently needed to avoid the delay and loss of time consequent upon taking them to and from the storage room. The purchase of such teaching aids and the cabinets, cases, and frames to contain them with district funds is as defensible as the purchase of books and the employment of teachers.

Drawing tables for work in farm mechanics and farm management, or temporary attachments provided for the regular class-room work tables, should be supplied unless the tables of some other school department can be made available for the agriculture work.

If the agricultural reference books are to be organized as a departmental library, suitable cases should be installed for them and for bulletins, and racks for periodicals.

A portable blackboard of wood pulp or of slated cloth is a great convenience and should be provided.

APPARATUS

The apparatus needed for teaching the various branches of agriculture such as agronomy, poultry, and others is mentioned in the chapters of this book devoted to those subjects. But it is well to call attention here to a few things of general serviceability in the teaching of any and all of them which each school should purchase.

A good lantern and a suitable supply of slides are essential. No high school should attempt to teach agriculture without them. There are five or six desirable types of lanterns on the market adapted to the use of electricity and of gas for illuminants. Definite information regarding their adaptability to different sets of conditions can usually be obtained from the college of agriculture.

Sets of slides to illustrate the different topics can often be borrowed from the State College of Agriculture or from the U. S. Department of Agriculture, or may be purchased from supply houses. They may be borrowed from commercial companies having educational departments. The head of the department of agriculture in the State College of Agriculture or the state supervisor of agriculture can give the names and addresses of such supply houses.

An opaque projector to throw on the screen pictures, diagrams, drawings, and other opaque material not of sufficient general use to warrant the expense of making into slides is valuable and ought to be bought, if the local source of illumination is sufficiently strong and funds are available.[2]

A good camera ought to be a part of the equipment to enable the taking of local pictures that have great educational value and cannot be made available for future use except in the form of lantern slides or opaque projection. The expense of the camera and of the supplies for taking, developing, and printing those pictures that are for school use should be borne by the school district.

Charts on muslin, oilcloth, or heavy paper or press board should be supplied at district expense to the extent needed by the school for its class work and for the community extension work done by the school.[2]

A motion picture projection machine[2] can be afforded by some schools and is found to be of great value. A large standard machine may be installed in the assembly room or other large audience room and used by the agriculture classes when films are available. Many of the national livestock registry associations of the different breeds of cattle, hogs, horses, and sheep have films for free service. These may usually be obtained from the secretary of the association. Obtain the revised addresses of livestock associations from your state supervisor of agriculture.

There are several small portable machines using non-inflammable films which can be used in any school-room without a booth. For these there are numbers of educational films. Such a machine may serve many schools of a district. More detailed information on the foregoing apparatus may be found in the chapter on Charts, Slides, and Films.[2]

A stereoscope of improved model with well selected views will add greatly to the teaching efficiency.[2]

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[2] See Chapter XVI and Appendix.

Typical specimens of grains in head (Fig. 179) and in seed, weeds, and weed seeds in convenient containers may usually be purchased from the State College of Agriculture or the school supply houses.

Pictures of plants, animals, machines, buildings, and farm equipment should be obtained even if they must be purchased. Provide many agricultural placards.

A duplicator such as a rotating mimeograph or a jelly pad hectograph should be in every school.[3] They will be useful in preparing survey topics, preparing special score cards for farms, for projects, for surveys, preparing outlines, programs, reviews, lesson plans, and lists of references.

Other Apparatus.—A good set of scales is so necessary at all times that the agriculture department should be supplied independent of the other departments. Many other supplies and some apparatus can be used coördinately with other departments.

In addition to the special apparatus mentioned in Chapters V to XII, inclusive, there should be a sufficient supply of wide-mouth bottles and screw-top bottles, of various sizes; glass and earthenware jars and crocks; cups, plates, trays, scoops; and wood and metal containers of various capacities.

Adapt Equipment to Local Use.—Not every school can afford the space and equipment just described, though it is what every good school of average size should have. Each teacher must study his curriculum, his classes, and his funds and come as near as possible to the ideal equipment. If agriculture is to be introduced into the school gradually, he may provide each year only those things most essential for that year's work, adding other necessities as other years of work are added. When all the most urgently needed features have been obtained, additional desirable ones may be added.

Very helpful suggestions for equipment will be found in Professor W. G. Hummel's "Materials and Methods in High-school Agriculture" (Macmillan) and Professor A. W. Nolan's "The Teaching of Agriculture" (Houghton, Mifflin).

Every piece of furniture and apparatus should have a definite place, out of the way of the regular class work, but easily obtained for use, *and should be kept there, clean and in good order.* Administrative officers should see that no more equipment and apparatus are supplied a teacher than he is willing to care for properly.

[3] See Appendix recipes.

EXERCISES AND QUESTIONS

1. Draw to scale a plan for a group of agriculture rooms adapted to a school of your acquaintance stating briefly the demands of the curriculum and the school.

2. Lay out to scale the floor plan of the combined class-room and laboratory of the school used in exercise 1, showing the location of furniture, apparatus, windows, blackboards, doors, and water, gas, and light conditions.

3. Make to scale a floor plan of a practical school greenhouse, showing its relation to the high school building.

4. Prepare a card index or other list of the various livestock and registry associations in the United States including your state and local ones with the names and addresses of the secretaries, from whom valuable pictures and printed matter may be obtained.

5. Draw to scale an elevation of the shelving required for a storage room with which you are acquainted.

6. Draw to scale a seating plan for a certain class and laboratory room which you know.

7. Enumerate the advantages of having pupils do their class and laboratory work at the same table; also of having all pupils face the front of the room instead of having pupils facing each other. The disadvantages.

8. Make a rough sketch of a cabinet for holding ear corn samples to have them safe and convenient for study.

9. For what *general* equipment would you spend your first $200? (Give name and price of each article.)

REFERENCES

Lists of equipment of the kinds mentioned in this chapter may be obtained from the following sources (see also sources of lists in Appendix):

Furniture, fixtures, and apparatus from the State Supervisor of Vocational Agriculture; the State College of Agriculture; the Agricultural Instruction Division, States Relation Service, U. S. D. A.; and the school supply houses.

Specimens of plants from the State College of Agriculture; the U. S. D. A.; commercial seed houses; Boards of Trade that deal in the various farm crops; and the school supply houses.

Pictures of animals from the various livestock registry associations.

Pictures (and occasionally small models) of machines from the manufacturers.

Miscellaneous special exhibits of manufactured products from the firms manufacturing them (obtain list from the Agricultural Instruction Division, States Relation Service, U. S. Department of Agriculture).

Farmers' Bul. 586, Collection and Preservation of Plant Materials.

CHAPTER XVI

HOW TO TEACH THROUGH CHARTS, SLIDES, AND FILMS

Growing Importance.—That "seeing is believing" has long been accepted as sound psychology. The sense of sight is one of the two major senses concerned in the learning process. Its value in object teaching and in textbook study have long been appreciated. Inventions and improvements have given a new significance to visual instruction. To the blackboard and the map, the only generally used means of visual instruction of the generation just past, have been added charts, stereopticons and slides, opaque projectors, motion picture films, stereographs, and other means of visual instruction for groups. All of these are especially helpful in teaching agriculture, particularly when real objects cannot be present for class use. The agriculture teacher who is not prepared to utilize these vital aids in his teaching is poorly equipped to meet modern demands and should lose no time in fitting himself to use them with skill and efficiency. The school which is not making provision to supply its agriculture department with the materials needed for carrying on this type of teaching is handicapping its pupils in their efforts to obtain the best in education. Charts are so easily made, pictures, slides, views, and the machines with which to project them are so numerous, effective, and relatively inexpensive that there is little reason for a school not having any or all of them for use especially in its agriculture classes. Motion picture projectors are expensive and film service both quite expensive and poorly organized at present; but as the enterprise is still in its infancy and undergoing very rapid development, schools may look for motion pictures to become both a practical and a relatively cheap means of visual instruction in the near future. Both teachers and school officers should not only be ready for that day when it arrives, but in the meantime should hasten its coming, whenever funds can be procured, by introducing it into their schools in the form of definite visual teaching.

Blackboard.—Few teachers make the most efficient use of the blackboard. Tables, drawings, diagrams, outlines, and similar representations for temporary use placed on the board before the pupils assemble may mark the difference between a superior lesson

and one that is only mediocre. Some agriculture and rural life stencils may be obtained[1] and reproduced upon the board. During the recitation the live teacher not only has pupils work on the board but uses it freely as a means of illustrating his teachings. In addition to the permanent blackboards the teacher of agriculture should have one or two sliding blackboards at the front of the room not only to increase the amount of board space but to keep

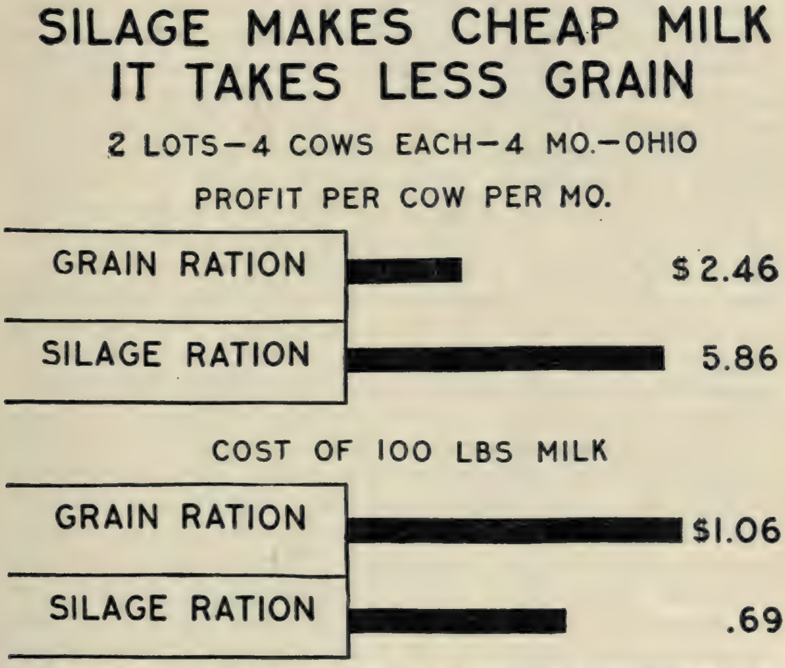

FIG. 183.—This arrangement of the bar graph permits the economical arrangement of explanations, data in figures, and relative magnitudes. (After P. G. Holden.)

obscured till needed certain material placed there before the recitation period. At least one (preferably more) slated cloth blackboard, mounted on wooden chart sticks or rollers, should be provided so that whatever is desired can be placed on it outside of the class-room and displayed at recitation time without loss of time. Both sides of the cloth being slated, a large amount of such work is made easily transportable from place to place.

[1] P. G. Holden, Director Extension Department, Harvester Building, Chicago.

Charts.—The chart is the most universally adaptable and uniformly effective and the most economical means yet discovered for concentrating the attention of a group of persons upon the thing to be taught (Fig. 183). It can be used in the class-room, in the laboratory, on the land laboratory, in a public assembly room, on the street, in a railroad car, in the field, at a picnic, a fair, a church service, a convention, or any other gathering, large or small, in natural light or artificial light, day or night, in sun or in shade. It requires neither special illumination nor inconvenient accessories. Made of proper materials, it may be destroyed after one use without great loss or may be used a thousand times with no other than the initial expense (Fig. 184). As the textbook is one of the best friends of the learner, so the chart should become one of the best friends of the teacher. It has special value to the teacher of agriculture because of being adapted not only to his class work in the school but also to his extension work in the community. Every teacher should know not only how to use charts but also how to make them, because much of the material he wishes placed upon them is local, or recent and changing. Not only should teachers make charts, but it is well to have students in high schools make them occasionally for use in reporting their projects or topics at community meetings, graduating exercises, or other public places.

Equipment and Materials for Making Charts.—A chart board of the size of the largest chart to be made is the first essential. School charts are sometimes made four feet square, or even 3 x 4 feet; but as charts for public use should not be less than five feet square, a chart board of this size (or preferably six feet square) is desirable. It should be smooth, straight, and without elevations or depressions that will prevent an even impression being made upon the chart materials by the working tools. The board should be of some wood soft enough to receive thumb tacks and not inclined to warp. The pieces of which it is made should be matched and cleats so attached to the back as to provide for shrinking and swelling. If the school is willing to go to the additional expense, a "glued up" board can be purchased that will neither shrink nor warp. A relatively inexpensive chart board may be produced by making a rough foundation of common light wood and facing it with a piece of pulp board of superior quality.

The chart board should be located where there is good light on it and where shadows from the worker do not interfere with the work. A heavy straight-edge about two and one-half to three

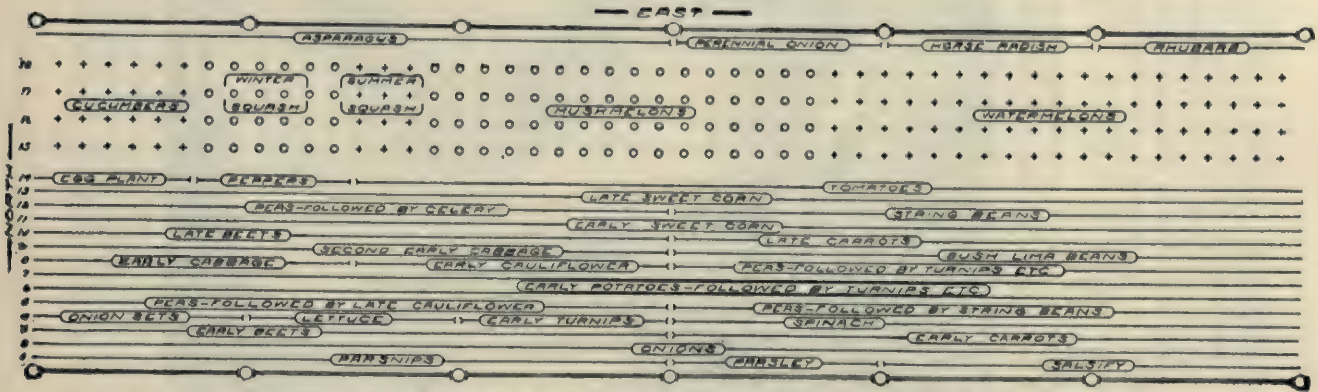

FIG. 184.—A garden plan, such as the above, may be placed on a chart or slide for frequent use. (Pennsylvania Farmer.)

inches wide and as long as the chart board is wide should be so mounted as to be held in place as a guide to the letters used in stamping or the crayon, or brush, or other instrument used in

FIG. 185.—This shows the chart board and frame described in the text, with a young lady of medium height or less working at it. If economy needs to be practiced, sacrifice on the frame and attachments and not on the board itself.

making the chart. If marked off into inches, it will be helpful in side spacing. This may rest on pegs placed in numbered peg holes that are along the right and left edges of the board.

The chart board should be mounted so it will be firm and steady. If it is to remain in one place, it may be mounted on a simple framework which is fastened to the wall. If the board is given a slight

slant backward at the top, it is better for work (Fig. 185). If the chart board is hinged to the wall, with loose-pin hinges, the bottom may be drawn out from the wall to any angle desired.

If money is available and a movable and adjustable frame and board are desirable, a braced framework rolling on heavy casters can be made and the board mounted so as to be raised and lowered by counter-balancing weights, operating cords passing over pulleys located at the top, or better, a chain and crank with ratchet and

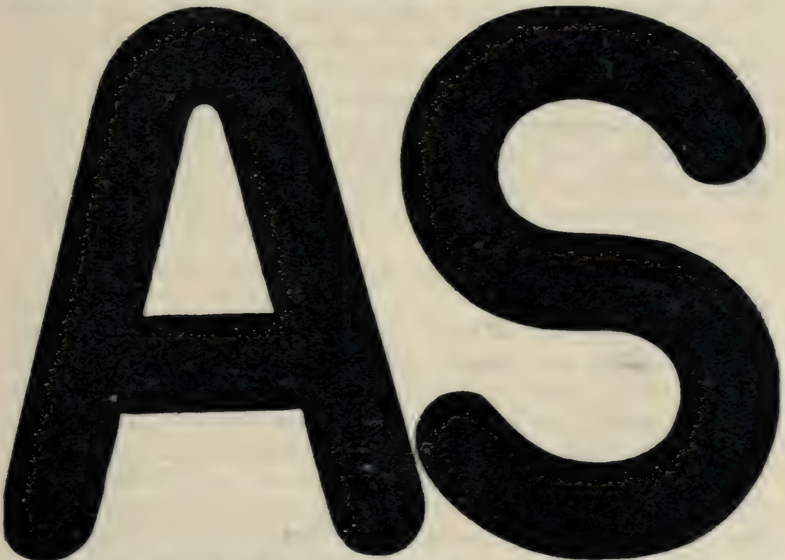

Fig. 186.—This is the style of letter to use in making charts. Free from all extra lines and uniform in outline, they are most easily distinguished. This is the three-inch size. Other practical sizes for chart work are 2½, 2, and 1 inch.

pawl. The straight-edge is then made to slide up and down on heavy rods upon which it can be fixed in position with thumb set-screws.[2] Provision is also made for mounting a roll of chart cloth so it can be drawn over the board and the chart not cut from the roll until it is completed.

Rubber Type.—Each school should be equipped with two or three fonts of single-letter rubber stamps. These should be of plain simple face (Fig. 186) and should have an elastic back, either Buchs cushioned back or sponge cushioned back, so they will

[2] Such an apparatus with a "glued up" board is in use by the Division of Agricultural Education, University of Minnesota. (Fig. 185.)

adjust themselves readily to the slightest inequality of surface or of pressure.[3] The large font should have a vertical measurement of three inches. Other useful sizes for charts are two inches and two and one-half inches. If a small font for explanations and other data, visible only at close range and hence not confusing to the audience, is desired, one of the same style of letter measuring one-half inch can be obtained.

Ink, Crayon, and Fixative.—A superior quality of black chart ink (rubber stamp or mimeograph) and large ink pads to hold it will be needed. Since even with the greatest care there will be occasionally a portion of a letter which is not well inked, and since attempts at making a second impression causes blurring and untidy work, a good quality of heavy black wax crayon should be at hand for retouching the letters. It will be needed also for drawing lines, filling in graphs and other drawings. If colors are to be used (and they should seldom be used and then sparingly), crayons will be needed for that purpose.

If freehand work is to be attempted, suitable brushes, pens, and pencils may be provided. A good form of chart ink or paint, for use with a small pointed brush, is made by mixing a little varnish with turpentine and lampblack. This can be made of any consistency to suit, and works well on sign cloth. Never use oil with it, as this causes the paint to spread in the grain of the cloth.

It is advisable to use a fixative on such work as is likely to "crock" or blur. Special caution is needed in this regard with crayon work. Such fixatives are to be used in a sprayer. They may be obtained from drawing-supply houses or made at the school, one part shellac to three or four parts of wood alcohol. Pastel crayons are good for color work.

Chart Paper and Cloth.—Charts to be used only a few times may be most economically made upon any tough colored paper and, if for a small group of persons, can be made sufficiently plain and in a short time by the freehand use of a good black wax crayon. This is much more economical of time and materials than to use the rubber stamps on cloth.

Charts to be used many times or before large audiences, or to be packed and unpacked frequently, should be made on a very superior quality of bleached muslin, about the quality of Pequot

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[3] Such alphabets of rubber type can be obtained from Salisbury-Schultz Co., Chicago; and wood cuts of the same from Curtis-Johnson Printing Co., Chicago.

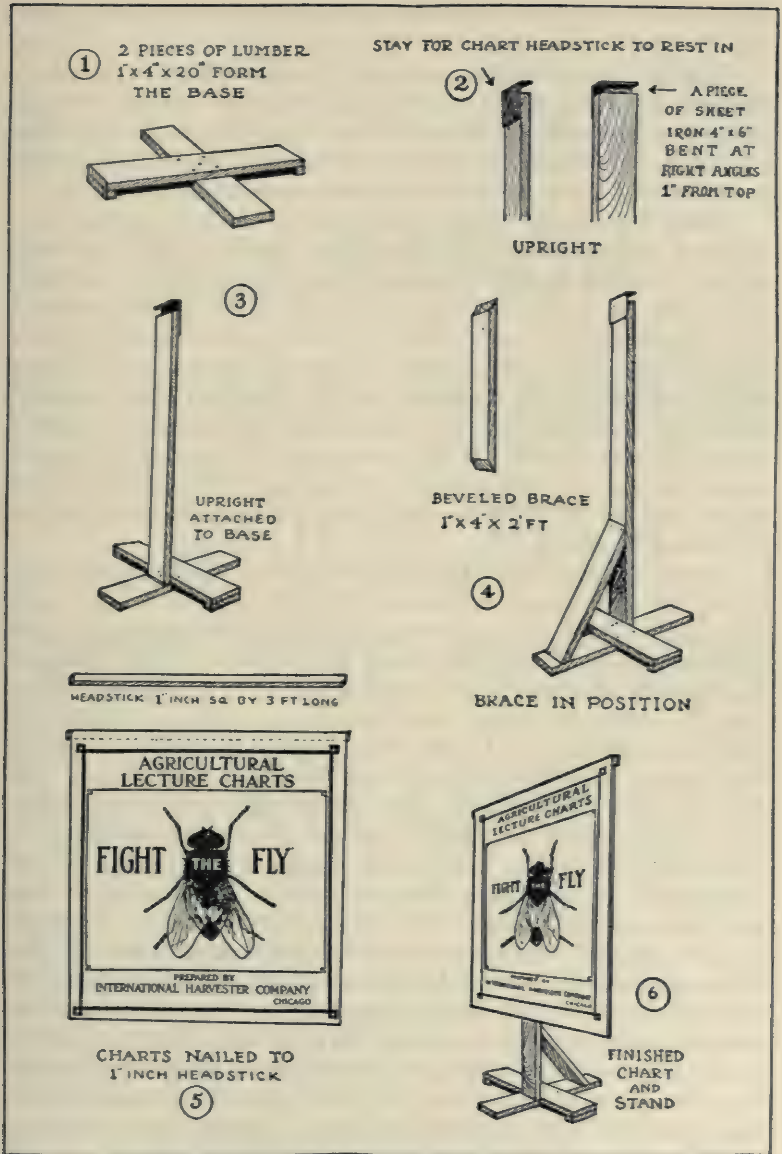

FIG. 187.—This chart stand can be made in the school shop and will serve well unless much traveling is to be done with the charts. (I. H. Co.)

or Golden State brand, 54 to 60 inches wide, by the use of the rubber stamp letters described.

Regular sign cloth, 36 inches or more in width, may often be found at dry goods stores. It is not as durable as muslin but makes attractive temporary charts. For the most durable charts, white oilcloth is sometimes used but is very heavy. Such charts should be rolled and never folded for carrying to meetings.

Chart Stands and Cases.—If a number of charts are to be assembled for use, or if one wishes to be prepared with a portable support and not depend upon conditions he may find in his extension work, an adjustable metal chart stand should be procured. If a simple stand is wanted for use in the school-room, it may be made by the pupils (Fig. 187). If it is desired to use the chart with others, they may be tacked at their tops to a plain wood bar as long as the charts are wide and about one inch thick and two and a half inches wide. If the charts are to be carried or shipped, a carrying case of strong canvas or carriage cloth held by strong straps and buckles and provided with a stout handle should be purchased or made.[4]

Suggestions for Chart Making.—Amateur chart makers usually fail of full effectiveness because of a few errors common to nearly all beginners. To aid in avoiding them these suggestions are made.

Plan with great care the subject matter to be charted. Be sure it is exactly what you want. Boil it down to an irreducible minimum by discarding every word that can be spared. Express the idea in words that will be clear and forceful to those for whom it is prepared. Be sure it is not capable of misinterpretation. See that big ideas stand out and that unimportant details are omitted (Fig. 188). Use striking terms, but do not sacrifice soundness for sensation. Make chart contents as applicable as possible to local conditions. Use local data whenever possible; it is more interesting and more convincing than is that from points far away. If graphs are used, see that they are simple in form, such as the bar or the line whenever possible. See that bases of comparisons are sound. The operator should lay off the lines carefully and count the words and letters as a sign painter would do. Have the copy carefully printed on the typewriter or lettered on paper in much the same style that it is to appear on the chart. If symbolism is to be attempted, remember that it must be simple, direct, and readily apparent to

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[4] Such stands and cases are now in use by the extension departments of many State Colleges of Agriculture.

meet with effective popular comprehension. Use the cartoon sparingly; it is a two-edged sword.

See that the chart cloth or paper is placed on the board with its edges parallel to those of the board. If the straight-edge guide is kept parallel to the top of the board and a T-square or triangle is used for vertical lines, drawings (Fig. 185), diagrams, and straight line graphs may be easily and accurately produced. Measuring

EDUCATION

IS THAT TRAINING

WHICH FITS

FOR THE DUTIES

OF LIFE

FIG. 188.—A few significant words well placed on a chart in clear, large type are more effective than many words much crowded. (After P. G. Holden.)

tapes or calibrations along the vertical edges of the board will aid in accurate and rapid measuring.

When placing on the chart, see that letters, figures and all characters are *large, plain faced, few to the chart, and far apart* (Fig. 189). Violation of this is almost universal, even by college professors. Most home-made charts use letters and figures that are difficult to read because of being too small and of having crooks and turns and tails and pothooks to the confusion of sight. Plain Gothic type is the best. As much is sometimes crowded upon one chart as ought to be spread out upon three or four. Note some in figure 190.

How can effective teaching be expected from such an abuse of a valuable teaching aid?

Three fundamental facts or principles or directions expressed

FIG. 189.—These charts have the good qualities of using rectangular surfaces (though bars would have been more effective), large, simple type, and no crowding. (S. R. S., U. S. D. A.)

FIG. 190.—Agricultural charts nearly cover the walls in this class-room. (H. L. Joslyn, N. C.)

in three to five words each on a chart five or six feet square by means of letters three inches high will make a lasting impression, while a large mass of details on the same subject crowded together in small type will be wholly ineffective. The chart is to present only the

outstanding features, the speaker or accompanying literature is to furnish the details.

Leave good margins at the top and the bottom. Do not crowd the right and left margins. Have *plenty* of space between the

THE PRACTICAL EDUCATION
TRAINS THE WHOLE CHILD

HEAD
TO THINK
TO PLAN
TO REASON

HEART
TO BE KIND
TO BE TRUE
TO BE SYMPATHETIC

HANDS
TO BE USEFUL
TO BE HELPFUL
TO BE SKILFUL

HEALTH
TO RESIST DISEASE
TO ENJOY LIFE
TO MAKE EFFICIENT

FIG. 191.—See that the subject matter of the chart is well analyzed, tersely stated, and effectively arranged. (After P. G. Holden.)

lines (Fig. 191). Have lines straight, letters erect and properly spaced. If graphs are used, see that relative magnitudes are properly proportioned. Remember that columns or bars of equal widths and relative lengths, or parallelograms of equal bases and relative heights, are the most easily comprehended by those little used to graphic representation.

Avoid three-dimension magnitudes and complicated figures.

Use simple, strong, outstanding lines for drawings. If colors or cross hatching are used for different quantities, make them easily distinguishable. Make the general execution of the printing and illustrating such as would make a first-class job printer proud.

Freehand drawing, if well done, may add to the usefulness of a chart but may add materially to the labor cost (Figs. 192 and 193).

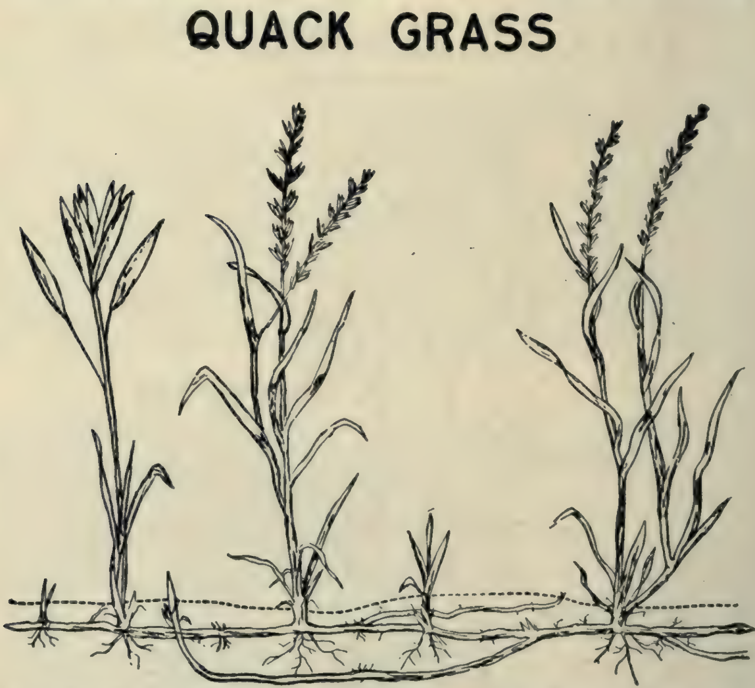

Fig. 192.—Freehand drawing is easily executed on a chart by throwing the image on the screen from a lantern slide. (After P. G. Holden.)

Such drawing may be done more successfully and economically by projecting on the chart cloth as on a screen the desired figure, using a lantern and a slide or opaque projector and then making the drawing from the illumination on the chart. If a slide be used, it may be necessary to turn the light off for short periods to avoid breaking it.

Stencils may be obtained commercially from which charts can be readily made, especially if the chart material be paper.[5] "Pay-

[5] P. G. Holden, Director Agricultural Extension Department, Harvester Building, Chicago, Ill.

zant," "Feed Ball" and "Spoonbill" pens and a good quality of round or flat showcard brushes are helpful additions to the equipment if much work is to be done on paper.

When printing and drawing are finished, go over the whole with

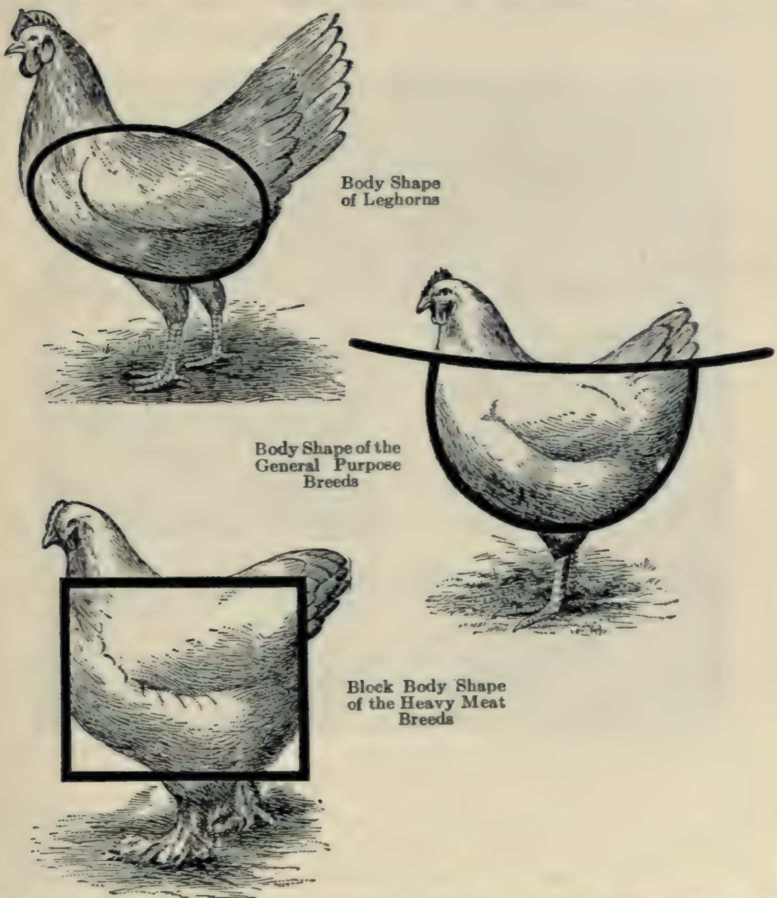

FIG. 193.—Figures for agricultural charts may often be copied from books, bulletins and catalogues. These three are from Lewis's Poultry Keeping.

a good quality of black wax crayon and retouch any weak spots. Then go over crayon work with the fixative, spraying it from a small hand sprayer similar to a perfume or medicine atomizer.

Errors may be obscured by sewing a piece of cloth over them

or by applying China white or Chemnitz white, or by applying tailors' mending tissue.

Using the Charts.—Charts frequently may be made to do teaching service without any person being present to talk about them. Charts used for this purpose must be quite complete and self-explanatory and should be so displayed that they are easily

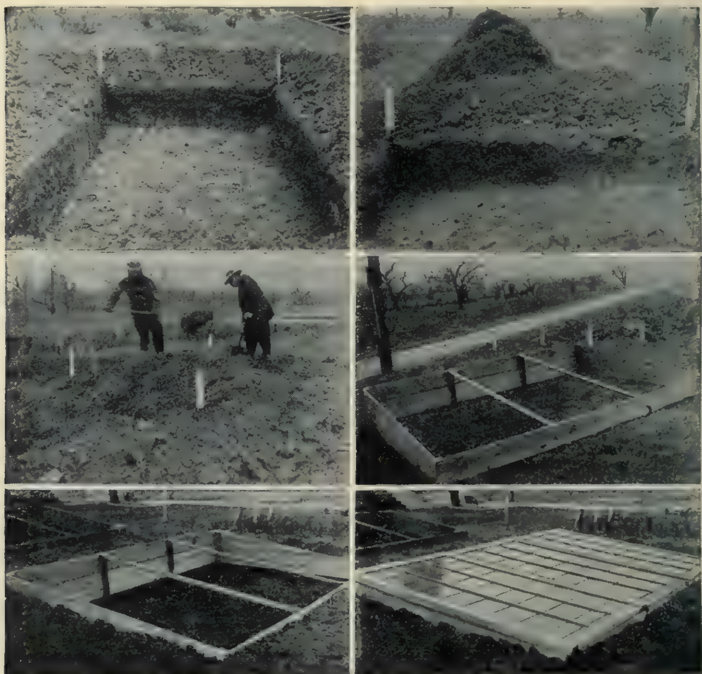

FIG. 194.—Collect or make pictures showing successive steps in various farm and garden operations, such as the six steps here shown for hotbed making. Use the sets of pictures on placards for your school room. (Kentucky Station.)

visible to those for whom they are intended. In using charts so arrange them that the class or audience sees only the chart upon which the teaching is concentrated at the time. Do not turn to a new chart until you have prepared your hearers for what it teaches, because as soon as it is exposed their attention will concentrate upon it to the loss of what you may be saying if you are talking upon a different topic. Place the charts where they are easily seen by all; care must be taken that those in the rear are able to see the bottom of the chart. The presence of charts should

not cause the speaker to omit the use of real objects. The best of charts are no substitute for the real thing. Have actual objects present when possible. They and the charts will be mutually complementary. As on any good class exercise, permit sensible, pertinent questions aimed at obtaining information, but do not allow your main purpose, which is to teach, to be thwarted by indiscriminate or voluminous questioning or by debate and wrangling. If there be charts in the set that are not applicable or that you do not wish to use because of lack of time, it is sometimes well to show them with a passing word of explanation rather than to appear to be keeping them obscured. Sometimes curiosity regarding the mysterious unshown chart will prevent concentration upon that which you desire them to learn.

Placards.—There is much use for placards in teaching agriculture. Cards of various sizes and qualities are used in making them. If pictures are to be printed or mounted on the cards, a good color for the card is gray. The cards should be heavy enough not to warp badly when pictures are pasted on them (Figs. 194 and 195). If a number of placards are to be made for use in the school-room and laboratory, it is well to have them uniform in size. A standard size of cardboard for this purpose is 22 by 28 inches.

Printed placards on many subjects may be obtained from the various offices of the U. S. Department of Agriculture. Teachers should obtain many of these and also ask their own state college for placards that are useful in teaching.

Students and teachers should make placards on many agricultural subjects. Illustrate them with pictures from farm journals, bulletins, and catalogues. Have the lettering neat and plain, as suggested for the cloth charts.

Such placards may be stored flat on a large shelf in a store-room when not in use. They may be easily provided with eyelets for hanging on the wall. When desired, such cards may be suspended in series or tiers, one card being tied to the bottom of the card above it. They are thus easily folded together when taken down for storage.

Maps.—The regular political and physical maps belonging to the school should be available for use in agriculture. In addition to these, outline maps should be used for many purposes. An outline map of the United States, of the state, and if possible of the region, painted upon slated cloth, should be a part of the regular agriculture equipment. Areas devoted to certain types of farming,

FIG. 195.—A live teacher will obtain a good supply of instructive pictures and display them advantageously. Except on special occasions, they should be well distributed around the room. (W. C. Christensen and S. R. S., U. S. D. A.)

certain crops or animals, and the areas in which certain conditions of soil or marketing prevail, or certain pests or diseases are preva-

lent, and countless other types of information can be illustrated on such blackboard maps. Outline paper maps of sufficient size for group use may be mounted upon pulp board and colored tacks used for the location of specified items of interest.

Small outline maps for the use of individual pupils may be used to record in graphic form some of the most interesting agricultural truths which will be better understood and more successfully remembered because of the pupil having thus worked out the truth on a geographic basis. All available maps of local, state, and regional agriculture, such as those relating to soils, animals, crops, and rural surveys, should be obtained. Enlargements of important census maps relating to agricultural topics of local interest may be worth making. This would not be difficult if a slide were first made and this projected as suggested in the making of charts. If there is a soil survey map of the state, it should be at hand at all times.

Lanterns.—In the chapter on equipment the owning of stereopticons and slides was advocated. There are a half dozen good makes of stereopticon lanterns on the market each with its strong points.[6] If the school does not own one, the teacher of agriculture should learn what sources of illumination are available not only in the school building but at the many points in the community where he will probably want to use the lantern, such as rural schools, farmers' club halls, stock pavilions, rural churches, fair buildings, and similar places. He can then choose the lantern best adapted to his needs in that regard. He must also know the approximate focal distance it will be possible to obtain in these various places and see that the lenses in the machine to be bought can be adapted to those distances without too small or too large an image or too slight definition. If he decides upon a machine that uses electricity, he must know whether his available current is direct or alternating and of what phase and voltage. If the places in which he expects to use it are not of uniform current, he must know whether he can obtain a rheostat or transforming device that will permit his using the same lantern on all circuits. Some lanterns can be furnished with an equipment for electricity and also one for gas. He will then need to decide whether his source of illumination, if electric, is to be of the arc or the incandescent type. The possibility of using a magneto light or storage light from an automobile, or of using a portable generator, should also be considered.

[6] To obtain list, see Appendix, p. 416.

So great have been the improvements in the incandescent bulbs that for ordinary use bulbs sufficiently powerful can be obtained, thus avoiding the many annoyances, such as noise and irregularity of feeding, which frequently mark the arc light. These bulbs may be obtained in 6, 12, 32, 90, 110, and 220 voltages. They need no resistance or controlling device and may be used interchangeably on alternating or direct current.

Ease of portability and ease, simplicity, and rapidity of setting up are important features, especially if much extension work is to be done. Range, accuracy, and ease of adjustment are other features that need attention. For many years the slide carriers were practically uniform in all machines. Recently some have added greatly improved slide handlers which when perfected promise much more convenient and effective operation. Such an improvement should be given due consideration in the selection of a machine, but before they are purchased care should be taken that such devices have been sufficiently perfected to be practical.

The Screen.—For the agriculture room a coated screen of sufficient size and of as good material as the funds available permit should be hung upon a spring roller at the front of the room. This spring roller and screen should be boxed in to keep them free from dust and dirt. Although a very good image can be produced upon a blank light-colored wall, it is well to have a portable screen of good muslin, or better sateen, to take to places where nothing else is available. It may be necessary to have some ropes and simple pulleys to make the use of this more effective in some places. Wrinkles and creases in this cloth should be avoided as far as possible.

Slides.—The lantern slide has made a place for itself not only in entertaining but also in teaching. With the simplifying of stereopticon lanterns so any teacher or careful pupil of high school age or even younger can operate them, with improvements in illuminants and their accessibility, and with the great increase in the number and quality of slides adapted to educational uses, the lantern has become almost universal in high schools and even in elementary schools. Like charts, they are especially adapted to group teaching, which is the almost universal system in use in this country. The teacher of agriculture can utilize them to very great advantage, and the supply of agriculture slides is rapidly on the increase.

Obtaining Slides.—Commercial dealers in slides are numerous.[7] The Forest Service and the States Relations Service of the United States Department of Agriculture, the Bureau of Education of the United States, the Agricultural Education or Agricultural Extension Departments of the various State Agricultural Colleges, and numerous commercial organizations have free slide service. Many private firms have special sets for loan or sale. Many of the commercial slide manufacturers will make to order any slides desired from negatives or photographs furnished them.

In addition to all these sources of supply many teachers make their own slides. With all of these opportunities, every agriculture teacher should find it possible to have sets of slides suitable for use in his classes. While the loaning and renting facilities available should be utilized to the best advantage, every agriculture department should gradually assemble by purchase superior slides covering the subjects most essential in his school work and community service. These slides should represent the most fundamental and important features of agricultural work and should be the best obtainable. To avoid burdening his slide cabinet with second-rate or irrelevant slides, he should purchase with the privilege of returning any not desired. By keeping a list of subjects which he desires to add to his supply he can select with care and see that the money spent is wisely distributed over the different topics taught. Besides the small choice selection of slides owned by the school, much use should be made of the constantly enlarging opportunities being offered for obtaining those offered for loan or hire.

Taking Pictures for Slides.—Some of the slides should be of local subjects or data which the teacher provides. If he has a camera and can operate it well, he should take these pictures himself. If not, he may engage the services of a local photographer. In either case he should see that the composition of the picture (what it contains and how the contents are arranged) is such that the teaching value for the purpose desired is fully brought out. Unnecessary objects that would distract the attention should be omitted and the others so placed and posed as to make plain the things desired. If relative magnitudes are to be made clear, some object whose dimensions are commonly known should be so placed as to make comparison easy and correct. Backgrounds should be chosen that will bring out in strong relief the contents of the picture. Careful study must be made of lights and shadows if clear

[7] See Appendix.

and truthful effects are to be achieved. Especially in the use of small cameras with limited focal adjustment care must be taken to avoid perspective distortion. Particularly in photographing animals, efforts must be made to avoid this distortion. Informality and naturalness, especially where processes are shown or groups depicted (Figs. 196 and 197), give the results greater teaching value.

It is well if the agriculture teacher is able to develop his negatives and print his pictures. But with the multitude of other duties required of him, in most cases after having seen that the negative is properly made he may better have the developing and printing

Fig. 196.—New Hampshire boys finishing a bridge graft on the trunk of an injured fruit tree. In taking pictures for school use or for lantern slides the students should be giving attention to their work as in the left view—not looking at the camera as in the other view. (R. A. Mooney.)

done by a regular photographer, if one is available. They will cost only a few cents each. These can be matted, covered, and bound by the instructor or students at the school. In case the photographs are so large as to require reducing to the lantern slide size, indicate on each photograph, by marks on the margin, the part which you wish to include in the slide. Data, pictures, diagrams, and similar materials found in books, bulletins or charts and maps which it is desirable to use in slide form may be photographed and thus made available.

Teaching Pupils to Take Pictures.—With the presence of a camera in so many homes it may be well to instruct the pupils of the agriculture classes in the fundamentals of proper picture taking especially as it relates to obtaining satisfactory farm views (Fig.

198). A competitive exhibit of pictures composed and taken by the members of the class, with awards by competent judges, will add zest to their endeavors. In the judging, the instructional value of the picture should be given consideration as well as its artistic merits. The use of some of the best pictures in the agricultural journals and in the local newspaper, with proper credit to the pupil and the school, will not only increase the interest in

Fig. 197.—It is well to make slides showing the steps in doing things, as in treating hogs for cholera. Four steps in a demonstration of the inoculation of pigs to prevent cholera. 1, the antiseptics; 2, the serum and virus; 3, the syringe and hypodermic needle; 4, injections into the pig. (R. V. Morrison.)

the picture-taking work of the school, but also in the agricultural work and in the local agriculture. The growing use of photographs in advertising farm products and in illustrating agricultural literature will justify spending a little time on instructing the pupils in the simplest and most essential feature of picture taking. Many of the pictures taken by the pupils will make satisfactory slides and will not only save the time of the teacher of agriculture but will supply views of local agriculture that he would be unable to obtain if he were to depend upon taking them himself. Pamphlets

upon photography should be in the library, especially if the pupils are to be given instruction in farm photography.

Making Slides.—To be able to make slides from his own negatives or photographs is a desirable capability for the agriculture teacher to possess, but to use his time in doing so when it can be

Fig. 198.—Take pictures of several steps in all projects. Arrange these on placards in the school to show development, or make lantern slides of some of the best. (G. R. Ransom, Okla.)

used to better advantage in some other way is undesirable. To see that pictures are properly taken and the slides properly used when made will be a far better use of his skill as a teacher. The district money will be most wisely spent if paid to regular commercial slide makers for making slides and to the agriculture instructor for devoting himself to his many responsibilities as a teacher and a community counselor. However, if the school is equipped for it, the teacher may occasionally make a few slides

in an emergency when lack of time will not permit him to obtain them through commercial channels. Detailed instructions for making slides may be obtained from library sources.[8] A sheet of gelatine on which desirable data have been written or typed placed between glass plates; a piece of ground glass upon which the data have been written with ink; plain glass treated with a one-to-twenty solution of Canada balsam in xylene and written on with ink—all furnish means for the teacher to prepare slides without the usual photographic processes.[9]

Improvements are rapidly being made in slides to reduce the weight and decrease the breakage. The library should be a subscriber to a good magazine so the agriculture department can keep informed of such improvements and see that the school avails itself of them.[10]

Fig. 199.—Revolving lantern slide transparency. Six faces, 7 slides high, 2 slides wide; top of one side removed to show structure. Improved by a light hanging inside. (Geo. A. Dean, Kans.)

Opaque Projection Pictures.—Any school provided with a good opaque projector and sufficient light to use it well, should select large numbers of pictures of suitable size for use with the machine. These should be mounted on small cards. Usually postcards and pictures cut from bulletins, magazines, and catalogues will be found useful for this purpose. Those on light paper may be mounted on thin cardboards of uniform size to suit filing cabinets. They may be arranged as suggested for lantern slides.

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[8] See "Lantern Slides—How to Make Them," Eastman Kodak Co., Rochester, N. Y., and brief article taken therefrom in Educational Film Magazine, Vol. I, No. 5, May, 1919, and Vol. II, Nos. 1 and 2, July and August, 1919. See also Appendix.

[9] See circular on "Use of Illustrative Material in the Teaching of Agriculture," States Relation Service, U. S. D. A., Washington, D. C.

[10] For list, see References, end of this chapter.

Stereographs.—The stereoscope and the more effective stereographs with their binocular arrangement for still pictures are valuable for individual use when suitable subjects are obtainable, but are not well adapted to group instruction during the class meeting unless there are enough instruments and views to supply the entire class, and even then the distribution and collection is time consuming and distractive of attention. For use during the study period they have a distinct value.

Moving Pictures.—The use of the moving picture as a means of teaching is rapidly gaining ground. As a means of entertainment it has already achieved a success that is nothing short of marvelous, but its progress as a means of actual school-room education has been less rapid and less satisfactory. In that field it is still struggling with some obstacles, but its possibilities are so great that there is no question about these obstacles being removed in due time. The expense of the projecting machines is being reduced by the manufacturing of smaller and less costly models. The expense of films is being lessened by more economical methods of manufacture. The lack of suitable films is being slowly overcome by the coöperation of teachers and producers in the making of films that are actually and not just ostensibly educational. The inefficiency of educational film service is being overcome by the development of coöperation among schools, colleges, and commercial film organizations.

In bringing about these changes, teachers in schools and colleges must take an active part, if the pupils are to receive the benefits to which they are entitled, from this highly potential source of aid to education. No longer must the educational film be accidental and fragmentary. The content of the curriculum must be organized into units capable of being filmed, these units must be arranged into pedagogic sequences, and the filming must be done with due regard to the psychology of the learning processes. America, which has produced the best textbooks in the world, must now produce the best educational films in the world. The general public demand, through the movie theater, will cause commercial firms to supply the fiction film as the same public demand has produced the fiction book, but the purposive efforts of teachers will be as necessary in the production of the text film as they have been in the perfecting of the textbook. Agriculture, dealing as it does with processes of applying science to the art of farming, furnishes an opportunity for using the moving picture to the greatest advantage.

When suitable films are obtainable through an efficient service

at a reasonable expense the moving picture will be a valuable aid in agricultural teaching. With the darkened room every obstacle to the concentration of attention is removed and the constant motion serves to keep the attention from wandering. Its vivid portrayal especially of processes and operations impossible in still projection or illustration adds to its teaching value. Showing actual conditions is a great saving of time over describing them, as would be necessary in talking or reading. The use of the moving picture will not supplant textbooks, libraries, laboratories, and

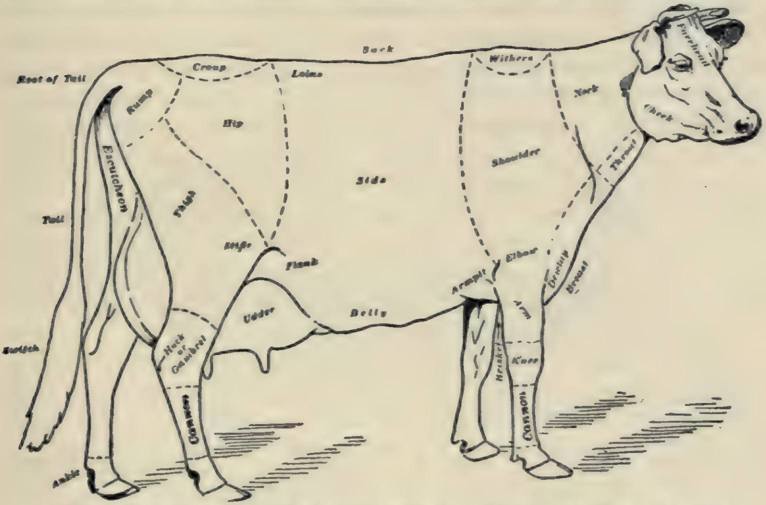

FIG. 200.—Suitable copy for school-room chart of dairy cow. (After M. J. Abbey.)

teachers but will improve upon the quality of their work in some features and will partly free them for better attention to those other features wherein the moving picture is less efficient.

The Moving Picture Projector.—The machine should be bought with school funds as is any other item of equipment for the class-room, the laboratory, or the library. If this cannot be done, paying for it through admission fees is permissible, but that forces the use of the machine, to some extent at least, as a mere entertainer when it ought to be recognized as a regular teaching apparatus with entertainment as a possible incident, if it is to play its proper part in the class-room. Some firms arrange to rent machines to schools, but that is a makeshift which the school authorities would not think of resorting to with blackboards, desks, or seats. Many

schools are equipping with projectors as a regular part of their apparatus, apparently considering them to be as necessary as maps, globes, and library books.

In choosing the machine attention must be paid to whether it is to be the standard theater type or the portable type, the source and character of electric current, and the distance through which it is to project. Most portable machines are intended to operate from a common electric light socket, and to project short distances using a Mazda incandescent lamp of about 250 to 400 watts. If a 600-watt light be used, the projection distance can be increased. Higher power Mazda lamps are made, but they require a stronger current. For the greater projection distances the arc lamp is required. If the machine is not to be moved from place to place, a permanently installed professional projector is more satisfactory. Until such time as standard films are made of non-inflammable materials it will be necessary to have such a machine placed in a fireproof booth, constructed to meet the insurance regulations and local legal requirements. This booth should be kept clear of unnecessary articles, especially those that are combustible, be painted black, and have all its openings so arranged that they close automatically if fire starts in the booth.

For portable use in places where there is an ordinary electric lighting system there are several machines of suitcase style that are complete and convenient. Where no current is available it can be provided by fixing a small electric lighting outfit upon a small truck or automobile. By this means motion pictures can be shown in a country school house or any other place even though no electric current is regularly installed there.

Some of the agricultural colleges are instituting courses in visual instruction through which prospective teachers are prepared, among other things, to operate stereopticons, opaque projectors, moving picture machines and other projection apparatus. Those who have not had the advantages of such instruction can obtain the fundamentals necessary by attending a short course at some central point or through the assistance of a local operator. It will be well to have one of the two or three good reference books that are on the market.

Obtaining and Using Films.—Films may be obtained by rental from the educational film exchanges, by loan from colleges of agriculture and the United States Department of Agriculture. In some states [11] a state coöperative film service is maintained. Many

[11] *E.g.*, North Carolina.

manufacturing firms loan films illustrating their processes.[12] Some of the livestock registry associations have films of their breeds which they loan to schools and colleges.[13]

In using the film the teacher should emphasize the teaching processes. Pupils should know what the film is intended to teach. An assignment should be made upon which the pupils prepare by using texts and references. Questions may be propounded to raise in their minds the problems which the film is to aid them in solving. The film and an abstract of its teachings should be familiar to the teacher before he makes the assignment to the pupils. The subtitles of the film should raise further questions in the minds of the pupils which the films may answer. Explanations through diagrammatic illustrations and proper labels should be used in the film to aid the pupils to a clear understanding. Much effective

FIG. 201.—Drawings such as this may be made upon charts and thus be available for use many times. (School and Home Gardening.)

teaching can be done in agriculture by the use of films. Land clearing, the operation of farm machines, types and breeds of animals, construction work, and especially the various drill operations to obtain farm skill offer unsurpassed opportunities for the successful use of the moving picture in agricultural teaching. By means of special equipment, which makes possible slow motion pictures, the motions in the various farm skills may be filmed and when projected slowly upon the screen make it possible to analyze them into their constituent movements, which may then be synthesized in actual practice and an improvement be made in the prevailing process if that be not the best. Spading, hoeing, raking, milking, grooming, harnessing, hitching, training, drenching, shoeing, caponizing, irrigating, tilling, stacking, spraying, adjusting machinery, and numberless other farm skills can

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[12] See Appendix.

[13] For list of associations, send to your state supervisor of agriculture for revised addresses. (Also see Appendix.)

thus be taught properly and after proper drill supplant less effective methods.

Pupils should be held as responsible afterwards for active and accurate *thinking* during this teaching process as they would be in any other. The illusion that because learning through the film and screen is easy it is to be a passive procedure on the part of the pupil

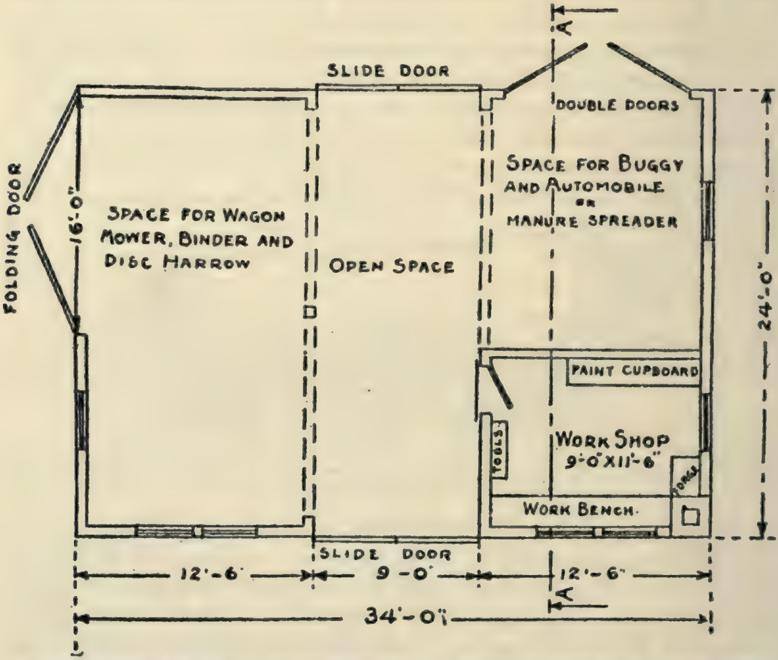

Fig. 202.—Make a chart of the ground-floor plan of a good machine shed, giving room for winter repair work and painting. A shed for the storing of machinery is a valuable asset on every farm. When properly cared for and well housed the life of machinery is considerably lengthened. It is said that more farm machinery rusts out than wears out. Proper storage prevents rusting out.

must be dispelled early if the greatest value is to be obtained from the lantern and the moving picture as educational adjuncts.

Filing and Storing.—Visual instruction materials should be very carefully filed and stored if they are to be ready when wanted and are to be preserved for long use. A record should be kept of all charts, maps, photographs, views, slides, and films based upon the library filing system in use in that school. Card indexes properly numbered with the same numbers on the articles should be em-

ployed. Charts and large maps should be neatly rolled or suspended at full length in a space where they will be free from dirt and injury. Small maps, photographs and views should be in vertical filing cases or in pasteboard boxes according to the system in use locally. These should be properly numbered and labeled so they can be found readily.

Films should be kept in a cool place slightly moist, and if inflammable, in metal containers in a fireproof storage space.

Slides may be kept in a regular slide cabinet with drawers con-

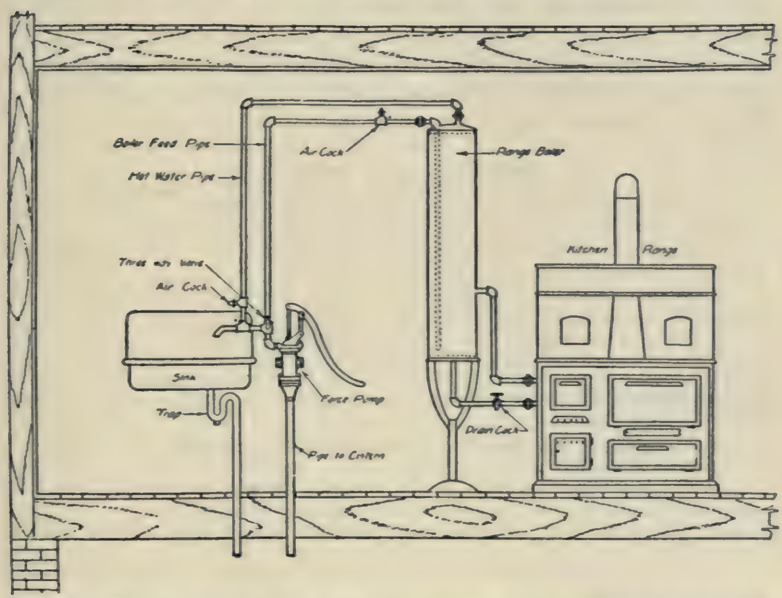

Fig. 203.—Plan of a simple hot and cold water system where the supply is to be pumped as needed. Make a chart like this for your shop-room. (After Cornell Countryman.)

taining separate slots for individual slides. If the slides are given a file number corresponding to the system in use, this number can be placed on the side of the drawer opposite the proper slide space. Each drawer can show on the outside the number limits of the slides therein. Or if they are arranged in topical groups, as orcharding, gardening, etc., these topics may be on the drawer labels. Slides may also be filed in a regular vertical filing drawer with a suitable follow-up block and a reference system by means of which any slide may be found easily.

Storing Slides in Visible Form.—Where many slides are owned by one school they may be arranged in large panels which slide into and out of a cabinet and which are quickly visible to the eye. These panels may contain from fifty to one hundred slides each and are quickly drawn out to be examined by any one planning a lesson or lecture. The cabinet containing these panels should be near a window so that the operator may look through them toward the light. A translucent screen may be used, if desired, between the light and the picture, thus enabling the operator to see the details more clearly, perhaps recognizing the slide more quickly. The arrangement of slides by the panel system may be either topical or numerical.

A revolving slide holder, such as that shown in figure 199, is useful at all times in showing slides to students and visitors. From it slides can be quickly selected for use in lectures.

EXERCISES AND QUESTIONS

1. Find the price of slated cloth blackboards of different sizes and where they can be obtained. What size is best adapted to your school?
2. Where in your vicinity can "glued up" chart boards be obtained? What will one cost that is 5 x 5 feet?
3. Draw a sketch of a frame that would support a chart board firmly against the wall; an easel that would support it; a movable frame on rollers.
4. Prepare the exact wording and arrangement you would use for a chart on improving the dairy herd or a similar topic of your own selection.
5. Discuss charts you can obtain as to wording, arrangement, spacing, style of type, graphs, forcefulness, clearness, and general appearance. Suggest improvements.
6. What are the objections to three-dimension graphs? To comparison by circles? Pyramids?
7. Make a chart on each of the subjects shown in Figs. 200, 201, 202, and 203.
8. Why not expose your most important chart to the audience while it is assembling?
9. In talking from charts how would you dispose of irrelevant questions? Impertinent ones?
10. Compare different samples of colored paper obtainable as to their values for chart use.
11. Find where slated cloth outline maps can be obtained most economically; also small paper outline maps of the United States and of your state.
12. Compare five different types of lanterns as to (*a*) illuminants; (*b*) portability; (*c*) convenience of setting up; (*d*) ease of operation; (*e*) adjustability; (*f*) slide shifting; (*g*) quality of illumination (when possible); (*h*) lenses.
13. Make a list of practical, portable stereopticons for the high school department of agriculture, with types of illuminants and cost of each.
14. Prepare a list of the names and addresses of dealers in stereopticon slides.
15. Make a list of stereoscopic views practicable to have as a part of the agriculture equipment.
16. Make a list of subjects of twenty slides you would like to have to illustrate a certain topic chosen by yourself.

17. State the advantages and disadvantages of glass plates for taking agricultural photographs; of films.

18. Make a list of motion picture machines using standard films; of those using special non-inflammable films and the names and addresses of dealers.

19. Obtain agricultural pictures and criticize them from the standpoint of teaching value.

20. Select five pictures, tables, or diagrams found in books or bulletins you would recommend to be made into slides. Give reasons.

21. Does your local paper use many cuts of local agricultural subjects? Could it use more to advantage? If so, find out the reason for not doing so.

22. Describe the latest improvements in slides to reduce weight and breakage.

23. Practice writing on a ground-glass slide until you can obtain a neat, clear result.

24. Practice with the gelatine sheet in the same manner.

25. Try the same upon a balsam-treated plain glass.

26. Obtain the names and addresses of educational film exchanges.

27. Prepare a list of five educational films adapted to the class in agriculture and state when you would introduce each into the class work.

28. What are the best types of incandescent lamps now available for use in lanterns? In motion projectors?

29. What current is available in your school? What lanterns and motion projectors can be adapted to it? How?

30. Are there any individual electric lighting plants in residences near your school? What kind? How much of such a plant would need to be transported to a place not having electric lights to operate a lantern or motion projector?

31. Does the Agricultural College of your state maintain a slide-loaning service? A film-loaning service?

32. What are some of the weaknesses of teaching by slides? By moving pictures?

33. Make a sketch of a cabinet suitable for holding medium-size maps, charts, and blue prints. What would it cost if made locally?

34. Are the photographs in your school so filed that they are well preserved and quickly obtainable? Do you think the system could be improved? If so, how?

35. Write to your State Agricultural College and see if plans have been made or are soon to be made for a state or inter-state exchange of lantern slides or films. When an exchange is started, join it if you can.

REFERENCES

"The Moving Picture Age."

"The Educational Film Magazine."

"Visual Education Magazine," Chicago.

"A, B, C of Exhibit Planning," Evartz G. and Mary Swain Routzahn.

Coleman, G. A.: M. P. in Educ. Jr. Ec. Entom. 10 : 371, 373, June, 1917.

"Use of Illustrative Material in Teaching Agriculture in Rural Schools," U. S. D. A. Year Book, 1905.

"Motion Pictures an Aid to Education," Vol. 1, U. S. Bur. Ed., 1910, 587–597.

American Assn. of Col. and Exp. Stations, Bul. O. E. S. 49, 1897.

Classification Scheme for Pictures and Lantern Slides, N. Y. State Dept. of Education.

"Use of Illustrative Material in Teaching of Agriculture," U. S. D. A.

"List of Films and Their Uses," U. S. D. A.

Leake: "Means and Methods in Agricultural Education," Houghton-Mifflin.

CHAPTER XVII

HOW TO ORGANIZE AN AGRICULTURAL LIBRARY

Importance of the Library.—The last quarter of a century has seen discovered and made available more scientific truth about agriculture than was ever known in all the preceding ages of man. No person can hope to get the most out of farming who is not acquainted with the best and most usable of this body of scientific agricultural truth. The teaching of agriculture contemplates not only that what is taught shall be practically sound but also that it shall be scientifically correct. While vocational agriculture must see that the pupil follows the best farm practices in his practical work, that is not enough. It must give him an understanding of the scientific bases for those practices and also give such a knowledge of the fundamental truths and principles of scientific agriculture and their relationships as to enable him to adapt them to varying conditions.

In the project system of teaching, every step in his practical work must be carefully determined after most thorough and thoughtful consideration has been given not only to the practical conditions which surround him but also to what the best scientific authorities say about that particular type of agricultural enterprise and those particular limiting conditions. These authorities must be found in the agricultural library of the school.

Even if each pupil owns a copy of the text used in the class work there will be need for the school library to furnish a large supply of other reference materials, because even the best text gives all too meager a treatment of any subject to be sufficient for practical purposes. Books, bulletins, papers, periodicals, special documents, reports, year books, circulars, catalogues, maps, charts, pictures, and many other forms of publications are needed to enable the pupil to obtain a thorough understanding of the subject and to prepare him for successfully practicing the farming operation involved.

What to Select.—There is almost no limit to the supply of good material available for the agricultural library. The two limiting factors are the demand of the curriculum to be taught and the supply of funds with which to purchase. With these in mind the teacher should discriminate carefully, in order that the money

available each year will add to the library the reference most valuable for the work to be done by that school. He must first go carefully through his curriculum and determine upon what phases of agriculture *which are to be taught the current year* additional reference material will be needed. He should then study carefully the available references *for those particular phases*, arrange them in the order of their serviceability and procure as many of them as the funds properly allotted to the different phases will permit. He should endeavor to obtain a few superior references for each important topic to be studied rather than many for one topic and none for others.

The largest amount of reference materials should be that which is adapted to the capabilities of the majority of the pupils to be taught. In addition to this there should be a small amount especially adapted to the teacher's use even though some were too technical for the pupils to understand. It is also advisable to have a small amount dealing in a popular and less technical manner with some of the affairs of the farm to use in arousing the interest of some of the less advanced farmers.

While most of the agricultural library material should be devoted to the study of farming it ought to contain a fair amount of choice material dealing with life on the farm. "The Fat of the Land," "From Sunup to Sundown," "Adventures in Contentment," "John, the Book Farmer," "The Fairview Idea," "The Brown Mouse," "Hidden Treasure," "Three Acres and Liberty," "Ten Acres Enough," "George Washington, Farmer," "The Soil," and similar stories of farm life and activities ordinarily placed on the fiction shelves may well be placed in the agriculture library, where they will attract the attention of the pupils studying agriculture, and their plans and procedure be subjected to class consideration and perhaps discussion.

In like manner some of the finest farm literature should be found in the agriculture library. The volumes of James Whitcomb Riley, the poems of Will Carleton, Liberty Hyde Bailey, Bryan, Sam Walter Foss, and others, and the several anthologies of farm prose and poetry are good examples. If agriculture is to do what it ought for the individual and for society, not only profit but also pleasure must be found in farming.

Books.—In addition to the one or more textbooks chosen for class use (and where they are purchased by the school there should be sets of several different texts) there should be a number of well-

selected books to which pupils may refer for more ample treatment of a subject than may be found in the text. Unless the school buys sets of different texts for class use, a few of the reference books may be of about the grade of the text used by the pupil. Several copies of each of the best should be available.

Others should be good college texts and other books devoted to special features of agriculture. In addition to these there should be one or more good cyclopedias, such as Bailey's Cyclopedia of Agriculture.

Bulletins.—Schools should supply for the use of agriculture classes the farmers' bulletins of the United States Department of Agriculture, those of the State College of Agriculture and Experi-

FIG. 204.—The supervised study of the week's farm journals, Easley High School, South Carolina. (L. M. Banknight.)

ment Station, and such additional desirable ones as can be obtained from other states whose agricultural practices are applicable to the local school region. Schools should also supply suitable cases in which to file all bulletins, properly labeled, and shelves or drawers in which the files may be placed in an orderly manner easily accessible for daily use.

Periodicals.—Schools should subscribe for a few of the best agricultural periodicals of local and national importance and provide suitable filing facilities so they may be available for class work and also for casual perusal of individual pupils (Figs. 204, 205, and 206). These are of greater educational value than much of the expensive equipment frequently found reposing in some dusty cupboard unused because it has too little relation to real life in that locality. If the school has a live agricultural teacher and pupils who are interested in farm life, the agricultural journals will contribute to the school work far more than their cost.

In addition to the general agricultural papers, those published in the interests of a particular breed of stock or a particular crop should be obtained when the local interest is sufficient to warrant.

FIG. 205

FIG. 206

FIG. 205.—The individual style of reading table on which to keep and use magazines. (Stanley High School, Wis.)

FIG. 206.—Large magazine table with compartments for agricultural journals. (Jas. T. Lovell, Tenn.)

Additional References.—The Annual Year Book and Annual Reports of the United States Department of Agriculture, the

Annual Reports of the Bureaus of Soils, and Animal Industry and States Relation Service, the Experiment Station Record, and the Crop Reporter of the Bureau of Markets, all from the United States Department of Agriculture, should be in the library. The Monthly List of Publications from the same source should be asked for by each pupil in the class so he can keep informed of what is available in the particular subject upon which he is working.

The library should be on the list of the United States Bureau of Education for all current publications, particularly for "School Life," a monthly devoted to school activities, including agriculture.

The publications of the Board of Agriculture of your state, especially all reports and the year book, should be obtained for past years and should be kept up to date by the addition of new numbers as they are published. If similar reports, year books and other official publications of the agricultural boards of nearby states can be obtained, they will make valuable additions.

Each school library should have all the non-technical and some of the technical bulletins published by the experiment station and the extension department of its own state and such of those of the other states having the same type of agriculture as can be readily obtained.

All bulletins and reports of the Federal Board for Vocational Education, Washington, D. C., and of the Board for Vocational Education in your state, as well as the bulletins, reports, and other publications of the state officers in charge of vocational education in your state so far as they relate to agriculture should be included. The school should be maintained on the mailing list of the Vocational Summary, a monthly, issued by the Federal Board. In many states the Department of Agricultural Education of the State University or State College of Agriculture issues bulletins, news letters, and other publications that will be of interest to the classes in agriculture. The various publications issued by the boys and girls' club leaders, the county farm bureaus, and by the Boys' Working Reserve contain much of interest.

Suggestive lists of library material suitable for a specific school can usually be obtained from the State Supervisor of Vocational Agriculture or the head of the department of agricultural education in the State College of Agriculture or University. Every teacher before selecting his library should obtain such lists and also the latest ones issued by the Agricultural Instruction Division of the States Relation Service, U. S. Department of Agriculture, the

U. S. Bureau of Education, and the Federal Board for Vocational Education.

Other Materials.—Besides the sources mentioned under "bulletins," various other institutions and organizations have materials to contribute to the reference resources of schools teaching agriculture. Printed material and pictures issued, sometimes free, by crop associations, livestock associations, commercial organizations handling agricultural equipment or supplies, and manufacturing and business organizations are frequently of genuine value and can often be used to advantage. Some discrimination must be exercised to prevent the insidious influence of unwarranted advertising creeping into the school.

Classifying.—If the library reference material is to be available for prompt and convenient use, it must be systematically arranged. The system used must be understood by those who use the library and each book, pamphlet, or other reference must have a definite place in relation to the others and must always be found there when not out for use. To accomplish this there must be a definite system of classification and a filing plan which corresponds to it.

The Dewey decimal system of classification is the one almost universally used in public libraries and the better school libraries of the United States. Superior as this system is in most subjects, agricultural science and the literature relative thereto have grown to such enormous proportions and have developed to such a high degree of differentiation that the original Dewey classification is recognized by librarians dealing with agriculture as entirely inadequate. Because of this, many attempts have been made to supply the need. Mrs. F. H. Ridgeway of Berea College published one [1] based on the Dewey system which is well adapted to the classification of agricultural books in a library of good size.

G. A. Deveneau, University of Illinois, developed one somewhat more brief based upon a decimal system but not using the Dewey basis of 630 for agriculture.[2] C. H. Lane, Director for Agricultural Education on the Staff of the Federal Board for Vocational Education, suggested a system which wholly abandoned both the decimal and alphabetic bases.[3] H. B. Fuller of

[1] Library Journal, Vol. 38, No. 10, Oct., 1913.

[2] See "The Teaching of Agriculture," Nolan.

[3] Federal Board for Vocational Education Bulletin No. 14, June, 1918.

the United States Department of Agriculture prepared a system [4] which is practically decimal, but does not adhere to the ten-unit basis. Carefully considering all these and others, the faculty of the Division of Agricultural Education, University of Minnesota, produced the following:

Classification of Books and Bulletins for Agricultural Libraries.

630 General:
- 0.1 Agricultural education.
  - .11 Organization and administration.
  - .12 Management.
    - .121 General.
    - .122 Class.
  - .13 Supervision.
  - .14 Methods.
  - .15 Visual instruction.
  - .16 Graphic representation.
  - .17 Research.
  - .18 Extension.
  - .19 Miscellaneous.
    - .191 Buildings.
    - .192 Equipment.
    - .193 Supplies.
- 0.2 Experiment station reports, etc.
- 0.3 Extension reports and general publications.
- 0.4 Collegiate education.
- 0.5 Short courses.
- 0.6 School of Agriculture.
- 0.7 Technology and sciences allied to agricultural subjects.
- 0.8 Dictionaries, cyclopedias, etc.
- 0.9 Miscellaneous.

631 Soils:
- 1.1 Soil surveys.
- 1.2 Soil physics.
- 1.3 Soil chemistry.
- 1.4 Soil tillage.
- 1.5 Cropping systems, crop rotations.
- 1.6 Soil moisture.
- 1.7 Manures and fertilizers.
- 1.8 Soil bacteriology.
- 1.9 Miscellaneous.

632 Field Crops:
- 2.1 Cereals.
  - 2.11 Wheat.
  - 2.12 Barley.
  - 2.13 Oats.
  - 2.14 Rye.
  - 2.15 Corn.
  - 2.16 Emmer and speltz.
  - 2.17 Grain sorghums—kafir, milo, and durra.
  - 2.18 Rice.
  - 2.19 Miscellaneous.
- 2.2 Legumes.
  - 2.21 Alfalfa.
  - 2.22 Clovers.
  - 2.23 Cowpeas.
  - 2.24 Field peas.
  - 2.25 Peanuts.
  - 2.26 Soybeans.
  - 2.27 Sweet clover.
  - 2.28 Vetches.
  - 2.29 Miscellaneous.

632 Field Crops (Continued):
- 2.3 Grasses—hay, meadow, and pasture.
  - 2.31 Meadows and pastures.
  - 2.32 Blue grass.
  - 2.33 Timothy.
  - 2.34 Millets.
  - 2.35 Prairie and native grasses.
  - 2.36 Sudan grass.
  - 2.37 Red top.
  - 2.38
  - 2.39 Miscellaneous.
- 2.4 Root crops.
- 2.5 Potatoes.
- 2.6 Fiber crops.
  - 2.61 Cotton.
  - 2.62 Flax.
  - 2.63 Hemp.
  - 2.64 Jute.
  - 2.65 Broom corn.
  - 2.66
  - 2.67
  - 2.68
  - 2.69 Miscellaneous.
- 2.7 Sugar yielding plants—beets, cane, sorghum, maple.
- 2.8
- 2.9 Miscellaneous.
  - 2.91 Tobacco.
  - 2.92 Tea.
  - 2.93 Coffee.

633 Horticulture:
- 3.1 Vegetables.
- 3.2 Orchards.
- 3.3 Small fruits.
- 3.4 Landscape gardening.
- 3.5 The wood lot.
- 3.6 Forestry.
- 3.7 Gardening.
- 3.8
- 3.9 Miscellaneous.

634 Entomology, economic zoölogy, plant pathology, economic botany and veterinary science:
- 4.1 Entomology.
  - 4.11 Bees.
- 4.2 Economic zoölogy.
  - 4.21 Birds.
  - 4.22 Rodents.
- 4.3 Plant pathology.
- 4.4 Economic botany.
  - 4.41 Poisonous plants.
- 4.5 Veterinary science.
- 4.6 Weeds.
- 4.7
- 4.8
- 4.9 Miscellaneous.

[4] Published in "The Visitor," Division of Agricultural Education, University of Minnesota, Dec., 1916.

Classification of Books and Bulletins for Agricultural Libraries.

635 Animal husbandry:
- 5.1 Beef cattle.
- 5.2 Horses and mules.
- 5.3 Sheep and goats.
- 5.4 Swine.
- 5.5 Poultry.
- 5.6 Nutrition.
- 5.7 Feeds and feeding.
- 5.8
- 5.9 Miscellaneous.

636 Dairy husbandry:
- 6.1 Production.
- 6.2 Manufacture.
- 6.3 Equipment.
- 6.4
- 6.5
- 6.6
- 6.7
- 6.8
- 6.9 Miscellaneous.

637 Engineering:
- 7.1 Farm machinery.
- 7.2 Farm motors.
- 7.3 Farm building and fences.
- 7.4 Roads and bridges.
- 7.5 Drainage.
- 7.6 Irrigation.
- 7.7 Surveying and mapping.
- 7.8
- 7.9 Miscellaneous.

638 Economics:
- 8.1 Farm management.
- 8.2 Coöperation.
- 8.3 Agricultural credit and insurance.
- 8.4 Markets and marketing.
- 8.5 Communication—telephone and telegraph.
- 8.6 Finance and taxation.
- 8.7 Labor.
- 8.8 Transportation.
- 8.9 Miscellaneous.

639 Miscellaneous:
- 9.1 Climate and weather reports.
- 9.2 Fishing, hunting, trapping, etc.
- 9.3 Rural sociology.
  - 9.31 Farm organizations.
  - 9.32 Country church.
  - 9.33 Rural betterment.
  - 9.34 Red cross.
  - 9.35 Y. M. C. A.
  - 9.36 Y. W. C. A.
  - 9.37
  - 9.38
  - 9.39 Miscellaneous.
- 9.4 Catalogues, seeds.
- 9.5 Catalogues, educational.
- 9.6 Catalogues, supplies.
- 9.7 Catalogues, apparatus.
- 9.8 Catalogues, equipment.
- 9.9 Miscellaneous.

Advantages of this System.—For a public school this has the following advantages:

It conforms closely enough to the Dewey system so it adapts the agricultural books to the remainder of the library and does not destroy the working system in the school.

It is sufficiently elaborate for a public school library.

It is not too elaborate to be adapted to bulletins and other pamphlets as well as to books.

It permits of any degree of expansion without in any way losing its proper place in the library system or overlapping any other subject.

By conforming to the Dewey system teachers and pupils are not burdened with two systems.

The agricultural material can be housed in its regular place in the general library or can be made a separate library in the agriculture rooms and changed back and forth any number of times without confusion or loss of efficiency. The books, bulletins, and other references are classified on the same basis.

With the system decided upon, the proper designation can be placed upon the back of the book and upon the upper left corner of the front page of bulletins and other pamphlets. This with the author's name will identify the book or pamphlet and determine its place upon the shelves.

Card Index.—All books should be card-indexed. A supply of cards, 3 by 5 inches, perforated for a rod, and an index case of two to four drawers with a rod to avoid misplacement or loss of cards are easily obtained and any librarian will give information about the process of indexing. In addition to other helps the Agricultural Index [5] which is a cumulative index to bulletins and agricultural publications will be of great aid in determining the classifications.

Bulletins may be card-indexed if desired. Many teachers prefer to use them without indexing to avoid the time and trouble not

Fig. 207.—Library and bulletin shelves in the center, with apparatus and specimens on the sides, in a Michigan high school department of agriculture. (W. C. Brown.)

only of indexing but of depending upon the card index in their use.

For many of the publications of the United States Department of Agriculture such as farmers' bulletins, year books, and circulars, index cards have been prepared which can be purchased from the Librarian of Congress.

Arrangement.—The books, bulletins, and pamphlets are usually stood with backs outward on suitable shelves. The bulletins and pamphlets are usually placed in pasteboard boxes slightly taller and deeper than the pamphlets and about three inches thick (Figs. 207, 208, and 209). On the back of the bulletin box is placed the decimal number and also the name of the subject with which the pamphlets deal. The bulletin boxes are then arranged on the

[5] Published by H. W. Wilson Co., New York.

shelves in the order of the numbers, if a numbering system is used. If a numbering system is not used, the bulletin boxes are arranged alphabetically according to the subject matter titles used, *e.g.*, alfalfa, beans, corn.

Another system of arrangement for bulletins and pamphlets less widely employed but strongly advocated is the use of vertical filing cases and guide inserts instead of shelves and pasteboard boxes. Though this system seems more expensive, careful estimates indicate that there is little difference if installed at the beginning. A regulation legal cap size vertical filing drawer of 24-inch depth will hold from 200 to 300 bulletins (standard size,

FIG. 208.

FIG. 209.

FIG. 208.—Side of laboratory in an Alabama high school showing cases and tables made by agricultural students. (J. B. Wilson.)

FIG. 209.—Bulletins for distribution to farmers are in piles on the upper shelves. Reference bulletins are in the pamphlet cases.

6 by 9¼ inches) by placing them upright in two rows. A four-drawer cabinet will thus hold approximately 1000 bulletins. With this system the classification is shown on the guides and on the drawer fronts. The cabinet is more elastic, more orderly in appearance, and more cleanly than the shelves and boxes.

Location.—If the agriculture pupils prepare their lessons in the school study room, using the agriculture rooms for recitations only, the agricultural library should be in the same room with the other reference material, but should be in a separate group easy of access for those who pursue agriculture. If double periods are granted the agriculture classes and they are allowed to prepare in the agriculture rooms, then the agricultural library with its index cards should be assembled there and a system of supervised study inaugurated.

Whichever system is used, if the agricultural library material is classified on the same basis as is the general library perfect coöperation is possible between the school librarian and the agricultural teacher. If the agricultural library is to be housed in the agriculture rooms, a duplicate set of index cards can be made which will leave the card index in the general library complete and unchanged.

Other Libraries.—The agricultural library should be supplemented when necessary by the use of the local libraries and by utilizing the facilities of any county or state traveling library available. Such facilities are increasing rapidly in many of the states and furnish opportunity for a larger use of references with a very slight increase of expense.

EXERCISES AND QUESTIONS

1. Name three books of fiction dealing with farming which you have read and which you think desirable for a farmer, as a farmer, to read.
2. Name five poems that depict farm life (not merely the out-of-door) which you would recommend for the agriculture library. Give reasons for recommendation.
3. Name three texts in addition to the one used by the class you would like to have the library obtain to use in farm crops; two in animal husbandry; one in poultry; one in horticulture; one in farm mechanics; one in farm management.
4. Make a list of reference books, including those mentioned in exercise 3, (*a*) you would buy with the first $25 available; (*b*) you would add with the next $25; (*c*) you would add with the next $25.
5. Make a list of (*a*) agricultural periodicals you would recommend if you were allowed ten dollars per year for such subscriptions; (*b*) five dollars additional.
6. Make a list of (*a*) U. S. D. A. farmers' bulletins desirable for your locality and curriculum; (*b*) your State College of Agriculture bulletins; (*c*) bulletins from the State Agricultural Colleges of five neighboring states, listing each state separately; (*d*) from miscellaneous sources, mentioning the sources.
7. Make a list of ten bulletins that you would like to have in the library relating to a topic in which you are specially interested.
8. Name three books on some phase of agriculture you would recommend for farmers of your acquaintance.
9. Name any papers which you know come into the neighborhood that are devoted to a particular breed of livestock or to a particular crop.
10. Does your state publish a year book of agriculture? How many have been issued? How many are in the library of your school?
11. Compare the classification systems mentioned in this chapter, choose the one you prefer, and give reasons for your choice.
12. Study carefully the classifying system used in your school or in a specific one familiar to you and explain its characteristics and operation.
13. Do the same with the card-index system.
14. Do the same with the shelf arrangement.
15. Give arguments for and against the shelf-pasteboard-box system of arranging bulletins.
16. Do the same regarding the vertical filing cabinet system.

17. Where should the agricultural library be housed in your school (or in a specific one with which you are familiar)? Why?

18. What other libraries are available for use in the school considered in exercise 17?

19. Has your county or state a traveling library system?

20. If so, explain how you, or your class, or your school can utilize it.

21. Get a state school library catalogue, if one is issued by your state, and check books suitable for your library. Suggest omissions and additions.

22. Look up the state plan for aiding schools in the purchase of libraries; learn steps in procuring this aid; obtain the blank forms used for this purpose.

REFERENCES

Hummel, W. G. and Bertha R.: "Materials and Methods in High-School Agriculture."

Nolan, Aretas W.: "The Teaching of Agriculture."

Stimson, Rufus W.: "Vocational Agricultural Education."

McCord, J. N.: "Textbook of Filing."

CHAPTER XVIII

HOW TO CONDUCT COMMUNITY WORK

Every school offering a course in agriculture should attempt to conduct work in relation to the community around it. It may serve a purpose in helping the farmers and others of the region. It may use the materials and practices of the region in giving instructions to the students of the school.

The School as a Community Center.—Much has been written by educators in the last few years regarding the importance of making the school the center for community action and community endeavor. The school building may be used as a meeting place. In this way the building serves a double purpose. Instead of remaining idle many hours of the day it is used for many late afternoon and night meetings. Among the meetings which are often held at the school houses are spelling schools, night schools, literary societies, general community clubs, parent-teachers' associations, agricultural clubs, story-telling classes, reading circles, farmers' institutes, short courses (Fig. 210), boys and girls' special clubs, community canning circles, sewing circles, coöperative organizations, dairy associations, fruit growers' associations, poultry associations, and others (Fig. 211).

Let the school serve as a center in the dissemination of knowledge, particularly in agriculture, home economics, and mechanics. The people should feel that the school is their own and that they can come to the school for information on any subject which concerns their home work and home life. The school should be so well equipped that it can give the information desired to any who may inquire. Much of this information may be given by means of literature or through books in the library. The school should have a valuable library which can be circulated among people of the community. It should not be of the common type of popular novels but may include the best of these. It should have sound books on topics which will help improve the life of the community and better the conditions found there. Much reading of good books will help the people of any community. A school orchestra (Fig. 212), or other means of supplying music, will aid in making the school an attractive center for the community.

Social Room.—The school should have a place where parents and others not regularly in class will feel at home. These social rooms should have comfortable equipment and furniture such as club rooms often have. In many cases communities have been willing to subscribe funds to provide and equip such rooms. They should be encouraged to place these rooms in the school building

Fig. 210.—For an institute held under the auspices of the agricultural department, the home economics students baked half a cord of bread, roasted 140 pounds of meat, and served the food furnished by the local commercial club. (J. A. Cederstrom.)

rather than in separate buildings, if the school is to be a social center. The cooking equipment of the school may be used on occasions when the community meetings are held at night or other times. The small expense for heating, lighting, and service may be met by special funds raised for the purpose.

The Agricultural Department and the Community.—The purpose of this chapter is to suggest and discuss methods by which the agricultural work of the school may be linked up closely with the farm operations of the region. The modern methods of teach-

ing agriculture through home project work aid materially in bringing the school and community together. Figure 114 is a map of a community in South Carolina made and used by an agricultural instructor in the high school.

For convenience let us consider the topics of this chapter

Fig. 211

Fig. 212

Fig. 211.—Community clubs may be called occasionally to meet on the farms of members and other times at the school. (A. Z. Arehart.)

Fig. 212.—An orchestra organized and perhaps led (as in this case) by the teacher of agriculture will aid in making the school an attractive center. (Albert F. Laurence, Minn.)

under two main headings: (1) How the community problems may be brought to the school, chiefly for the benefit and to supply materials and problems for the use of the school. (2) How the school work may be taken out to the community, either for the benefit of the students or for the benefit of people in the community or for both purposes.

BRINGING COMMUNITY PROBLEMS TO THE SCHOOL

Let us first consider how materials and problems of the community may be brought to the school for the aid of the work in the school. By the use of things which are furnished by the people the community itself is linked a little closer to the school.

Seed Corn to be Tested.—In the winter season when the class in field crops is ready for practice in seed testing, let corn or other seeds for that purpose be brought from farms of the region. Suppose that Farmer A has several bushels of seed corn stored which has not been tested. By inquiry some member of the class may be able to give the information, and the corn is located. Arrangement can be made for the corn to be brought to school and kept on trays, or on shelves, or hung on rope ladders or other devices. Let the students have the necessary practice in testing a few kernels from each of the ears of corn in the lot. After the testing is over the students should do the culling necessary to give the owner the desired information regarding any ears which are not fit for planting. The corn is then returned. If more practice of this nature is desired, other lots of corn may be brought from other farmers.

Corn for Judging.—Material for exercises in corn judging and corn selection may be obtained from farmers of the community. They will be glad to furnish the corn for this purpose. Most of it will be returned eventually to the owner. Perhaps the ones for judging may be used also for testing, and the owner will receive much benefit by having it tested and culled before planting it.

Grain Judging and Seed Testing.—It often occurs that seeds of certain crops are in bad condition and should be tested before planting. Wheat, oats, peas, beans, etc., may need careful examination, judging, and testing before they are planted. Farmers may be asked to furnish large enough samples for these purposes, and all students will receive good practice in grain judging and seed testing.

Seeds to Inoculate.—Offers may be made to inoculate legume seeds for farmers of the community. Students need practice in doing this work. A suitable place is the school laboratory. Material for inoculation is usually available in the soils at the school. If necessary, inoculation materials may be obtained from other fields, or from artificial cultures. It should not be announced that the school will do all the inoculating which all farmers may want done. But enough work of this kind should be secured from

the community to teach students how to handle the materials and seeds well. Let them learn different methods, as the agglutination method, the artificial culture method, and the soil method. The seeds will, of course, be returned to their owners ready for planting. The farmers and students have both been benefited.

Seeds to be Cleaned at the School.—In regions where clover, timothy, or other legumes or grass seeds are threshed for use or for sale, these may be brought to the school, where a fanning mill is to be operated by the students. If the fanning mill is not owned by the school, it can perhaps be secured for the purpose by borrowing it from some farmer or from an implement dealer. All the students in the field crops class should learn to know the problems of seed cleaning and learn how to manipulate the seeds and the machine. They should become skilful in determining the sizes of sieves to be used, and in determining the necessary speed of the fan in the mill. If the seeds such as those before mentioned are not available, common small grains may be used for the purpose.

Other lessons to be learned in these exercises are the sizes and weights of the different kinds of weed seeds. They should learn to know what kinds of trash and other inert matter are most quickly found in the different seeds run through the mill. Percentages of impurities of different kinds may be determined by weighing before and weighing the products after cleaning.

Grain to Treat for Smut.—Let samples of oats, barley, and wheat be brought from farms of the region to be treated to prevent smuts of different kinds. Several methods of treatment may be practiced by students. The hot-water method, the copper sulfate method, and the formalin method may all be tried and the results compared in the season's crops. By furnishing the grains for these exercises, the farmers will secure treated seeds free from smut which will aid materially in growing better crops the following season. Other farmers of the region may wish to have the school treat field seeds also. This may not be necessary so far as practice of the students is concerned. Enough practice must be given to the students to enable them to do the work well and not overlook any of the essential steps in the operations. Members of the class may thus be encouraged by other farmers to do similar treating by the formalin method on farms of the community. This may be with or without compensation.

Potatoes Treated for Scab.—Let one or more growers of Irish potatoes supply seed potatoes to be treated at the school to pre-

vent the development of scab disease. Facilities for treating the potatoes may be arranged in advance and a definite time set for the operation. Arrangements can usually be made for the farmer to have a wagon load or less of the potatoes hauled to the school at that time. The best methods of treating seed potatoes may be practiced by the students working in groups. If desired, the lots treated in different ways may be kept in separate sacks when they are returned to the owner. He may be so instructed as to be able to keep these separate at planting time so that results can be compared in the next crop.

Scions to be Grafted.—An offer may be made to the farmers of the region by which they can bring to the school scions from their best apple trees to be grafted on to roots by students at the school. The offer should limit the work or number of scions so that the school will not be overburdened with too much practice material. The offer should be made in late fall, and the scions when brought should be properly labeled with variety, owner's name, and the number of grafts he is to receive in return. Each farmer may be charged a few cents each for the grafts, if necessary, to cover the cost of apple-seedling roots used in this exercise. The stocks may be purchased from large nurseries in the Middle West and stored in moist sawdust in a cold cellar until used. When the students are ready for practice in root grafting they may be assigned to each lot of scions for practice. After each student learns to make perfect grafts, the next point should be speed. This skill and speed should both be attained by all members of the class. Each lot of grafts is carefully labeled on small painted wooden labels with the variety of fruit and the owner's name. Some student should keep a record at each laboratory period of the varieties, number of grafts made, and the owner of each lot. These are again stored as before to be held until spring. They will then be delivered to the owners to be planted almost entirely beneath the ground in rows in the garden where they can be cultivated one season.

In this exercise many surplus scions may be obtained for use in planting a small school nursery. These may be grafted, stored, and planted. The growth and care of small nursery trees on school grounds will furnish other good lessons in fruit growing.

Cuttings of Small Fruits for School Use.—Students of the class may be asked to bring to the school from their home farms prunings from small fruits such as currants and gooseberries, and roots

of blackberries. They should bring prunings from grape vines in early winter. They may also bring cuttings of ornamental shrubs, such as privet hedge, Japanese rose, dwarf barberry,[1] golden bell, and many others. From these prunings suitable cuttings may be made for future planting. These may be stored in cold cellars in damp sawdust to callous until spring planting time. They may then be set deep in the ground in garden rows.

Strawberries and Other Perennials to Plant.—In community surveys or in trips of the class it may be found that some farmers of the region have many surplus plants of certain kinds which they are willing to divide with the school. Students may bring these to school for starting plantations on the land laboratory. Among such plants that are thus found and supplied may be any or all of the following: Strawberries of several different varieties, clumps of asparagus for beds, rhubarb that needs dividing, peonies that need dividing and thinning, lilies of many kinds, iris, daffodils and narcissus, cannas, calladiums, roses, and many kinds of ornamental shrubs.

The school may thus be able to obtain many suitable plants for ornamental planting as well as those of economic value. The students will receive benefit in knowing how these plants are transplanted and propagated. They may also have good lessons in establishing beds and in arranging ornamental planting.

Fruits to Judge.—Students may bring from their homes exhibits of apples or other fruits to be shown at the school as they would show them at fairs. Some of these may be arranged on plates and used by students in the study of varieties and in judging specimens.

Some of the apples may be brought in boxes for use and may be used by the students for practice in packing. Unsorted fruit may be used in sorting and grading exercises. After fruit has been sorted and graded according to size, different sizes may be packed by different systems.

Insect Enemies.—On every farm there are insect enemies which are not well understood. Farmers of the region should be encouraged to bring specimens of such insects to the school for identification and study. Many questions in the farmer's mind are easily settled by the school. Students will receive benefit in identifying the specimens and in investigating the life history of various kinds and in methods of control. In many cases, students who have learned

[1] Avoid the common barberry, which harbors grain rust.

how to look up insect literature may be assigned to the problems presented by farmers. After enough training all members of the class may be enlisted in such work.

Plant Diseases.—When farmers find various fruits, field crops, or garden crops affected by diseases they should bring the parts or plants affected to the school. Other students and instructors may make good use of the material and may be able in most cases to assist the farmer in solving problems of fighting the enemy.

Noxious Weeds of the Region.—Numerous questions should be asked by people in the community regarding certain strange weeds introduced from time to time from other regions. The length of life, nature of growth, methods of spreading, and other information regarding the weeds can be obtained from students or the instructor at the school. Students will get much benefit in studying such specimens and looking up literature regarding each kind of pest. Farmers should be instructed regarding the best methods of eradication and control. They may be shown what kinds of rotation of crops will best destroy certain types of weeds with least labor. The slow, laborious ways of fighting weeds should always be condemned and supplanted with the easy wholesale methods.

Farm Machinery to Repair and Study.—On some farms of nearly all regions machines can be found which need considerable repair. Students in farm shop work may need just the practice which this machinery would supply. Classes will thus get practice in replacement of old parts with new ones and in doing all kinds of repair work. The farmers may be willing to pay for the repairing done by students, and should at least pay for the new parts furnished.

Schools in need of such practice work should try to locate in their communities suitable machinery for the purpose; an automobile engine, a badly worn tractor, a stationary engine, a binder, a corn harvester, a thresher, a mower, a wagon.

Planning Farm Structures.—When the classes in farm mechanics and engineering are ready to plan farm buildings, it may be possible to find some farmer in the community who is about ready to consider plans for a barn, dairy house, or other structure. Get this farmer to tell the class what he needs: approximate size, number of animals (if a barn), feed storage needed, special rooms desired, slope of the ground, materials most available, limits of cost. Assign certain students or the whole class to the problem. They will get much more training from studying and planning a real structure than one which may never be built. The farmer will doubt-

less get a better planned structure than if he planned it himself or built it without any definite plan. Students should make drawings of the floor plans and certain elevations and sections. They should also make a detailed list of materials required for the structure.

If this problem can be worked out on a building which is typical in size and other respects, it may be used by several farmers later. It will thus serve as a type of good structure for the community. In that case it should bear the name of the school or the name of the farmer who first built it.

Ventilation of Buildings.—In middle and northern climates, the King system of ventilation or some other good system should be installed in farm barns. Farmers deciding to install such a system should come to the school to get plans that may be suited to their particular structures. After stating their problems to the class, suitable plans should be furnished by students to each farmer.

Milk and Cream to Test at the School.—Farmers should know more definitely the producing powers of members of their dairy herds. They may be induced to bring in samples of milk of each cow in their herds for the school to test. The weight of milk and the presence of butter fat are two important factors from which is determined the value of each milch cow. In dairy regions farmers are keeping cows that do not pay for their keep. Farmers should be taught to weigh their milk and to take samples carefully. They can systematically bring these samples to the school for testing. Poison tablets to keep the samples from spoiling may be furnished by the school. The report of a cow's production should be calculated by students after adding weights for a given period and multiplying this by the percentage of butter fat found in the test. The immense money value of close coöperation in this work by the community and the school can hardly be estimated.

Animals for School Instruction.—Farmers can bring to the school specimens of cattle, horses, sheep, hogs, and poultry for use of students in animal husbandry in judging work. Instructors knowing the location of suitable animals in the community can usually secure them for this purpose. Owners are often glad to have their animals thus exhibited and used. The loan of the animals should be treated by the instructor as a concession to the school—supplying something which the school greatly needs. The owners will usually obtain good training themselves while their animals are being studied by students.

Classes should be ready to make the best use of the animals while they are there. All preliminary studies for the work should be completed in advance. The actual use and practice work should begin and continue during the period planned while the animals are there. A place to keep the animals should be provided in advance. All schools should plan to have pens or other more suitable quarters where such studies can be pursued. The animals may be driven or hauled to and from the school by the owners when desired.

Some of the exercises with horses brought to the school may consist of examining them for unsoundness, for blemishes, and for malformations. Other exercises with animals may consist of treating them for disease, or for other purposes. Specimens exhibiting certain characteristics of structure, gait, or other peculiarities may be used as object lessons in class instruction. Examples of breeds of the different classes of livestock may be brought to the school to illustrate the types or breeds. All the classes of farm animals, including poultry, may be brought at different times to the school for this purpose.

Soils to Test and Study.—All regions of the community should supply soil samples to the school. Fresh samples may be tested for lime, for acidity, for amount of organic matter, and for water-holding capacity. Samples should be kept permanently in jars or bottles. The labels should show on what farms or what fields they were taken, with date and results of tests. These can be used by classes studying soil maintenance and crop production whenever occasion offers.

TAKING THE SCHOOL WORK TO THE COMMUNITY

There are chiefly two purposes in attempting to extend the activities of the school throughout the region: (1) to give the students practice or instruction with materials, and objects, found in the community; (2) to aid members of the community in the kinds of work which students are pursuing. These two purposes may often be combined and, indeed, usually should be combined in all of the extension work of the school. It should be noted here that this chapter does not deal with the home project work of students, which is in itself an important phase of community extension work. How to Conduct Home Project Work is the title of another chapter in this book.

Lines of Extension Work to Encourage.—The agricultural surveys made through members of the school should serve as a means

of knowing what kinds of extension work to pursue. The instructor will grow more and more acquainted with the agricultural conditions of the region. He can better select lines of work which will be of value to the farmers of the community. He will know better what places are most suitable for giving the desired instruction to his students.

Under the following headings are discussed a number of topics with suggestions for working out details regarding the work of the school in the region. A few schools may find some of these lines of extension work not suited to their local conditions, but it is believed that from the list may be selected a number of valuable kinds of work, the pursuing of which will benefit both the school and the people of any region.

Lessons on Poultry Farms.—Take the students to important poultry plants of the region. Let each trip be for a particular purpose. Many incidental lessons can be learned on every trip. Suppose, for example, that the people of one region desire a lesson on culling poultry for the laying flocks. The class may be taken in carry-alls or in automobiles to a suitable place where plenty of birds are ready for the exercise. Let every student and, so far as possible, every member of the community have practice in actual culling fowls after the points in culling have been reviewed at the place. This makes the lesson practical for both students and people. No student can become an expert in such work without practice. On another occasion the special practice work may be in caponizing. At another place disinfecting houses, or otherwise stamping out a disease, may be the chief object. Read again the points suggested under the head of poultry trips in the poultry chapter.

Lessons on Dairy Farms.—Some of the special lines of practice for students taken out to dairy farms are the following: Selection and culling young stock for the future herd; selecting and culling producing cows (Fig. 213); the registration, numbering, and earmarking of animals; the treating of calves to prevent horns; the dehorning of animals; the castration of calves; the study of methods of feeding and management and improving of these; the making of calf-feeding stanchions; the installing of cement floors, mangers, and manure gutters; the installing of tracks, and litter carriers and feed carriers.

A number of other suggestions regarding dairy trips have been given in the chapter on dairying.

An Example of Extension Work with Swine.—Many agricultural teachers have taken their classes out to swine farms to treat herds against cholera. When such practice is to be given, the instructor should be certain that authority, if necessary, has been obtained from state officials for the handling of cholera serum or virus or both. Let all students understand and practice the methods of disinfection of instruments and skin of the animal. Let them all have practice in managing the animal to be treated. Let all have practice in using the instruments and materials. Let the owner also have practice in all of these for his own future needs. In connection with such a trip the students should learn the dosage tables and should drill on points of difficulty. They should learn the probable causes of failure and the remedies for these. If any cholera is manifested, all should study the symptoms carefully. If a dead pig has been found, a post-mortem examination should be made, and the definite marks of cholera on the kidneys and other parts should be noticed. All such work should be in full harmony with local veterinarians as well as state authorities.

Other Lessons with Swine.—Among the special objects of trips to farms where hogs are raised may be mentioned the following: The study of special breeds or study of certain families of breeds; the study of special methods of managing hog pastures and other lines of feeding; the treating of hogs for lice, worms, and other enemies; the castration of pigs; the judging of animals and selecting the breed of stock both male and female; the registration, numbering, and ear-marking of pigs; the making of hog cots and special swine appliances. Refer again to the swine trip suggested in the animal husbandry chapter.

An Extension Trip for Work with Sheep.—Good practice for students in many schools would be the shearing of sheep and dipping of animals after shearing. All students should be given practice by shearing several animals. They should learn how to handle the animals, how to shear by hand and by machine clippers, and how to take care of the fleece. After the shearing exercise is over, students may be given practice in judging fleeces and estimating weights.

In many sections of the country, it is a good practice for owners to dip sheep after shearing. This is to combat ticks, scab, and other external troubles. Students and owner should make a vat, or at least study the structure of a good dipping vat, learn to make

suitable mixtures for different purposes, and learn to manage animals before and after dipping.

Other Lessons with Sheep.—Among the other special lessons (Fig. 213) learned on trips to farms where sheep are kept the following may be mentioned: Making or otherwise studying suitable winter quarters for pregnant ewes; the winter feeding of hot-house lambs; the structure of feeding racks and other sheep

Fig. 213.—On a neighboring stock farm these Missouri students obtained good practice in judging sheep and dairy cattle. (J. A. Wisdom.)

appliances; the operation of docking; treating of hoofs; castration; the selection of breeding stock and other judging of sheep; the marking of pedigreed stock; the management of ewes and lambs at lambing time. In connection with the last mentioned topic, students should be given practice in making ewes own their lambs, in making ewes adopt orphan lambs, and in making ewes whose lambs are dead adopt lambs from pairs of twins.

Lessons in these points can be learned by the owners at the same time. In all of the topics mentioned let students and owners get as much instruction and actual practice as the occasion offers.

An Extension Trip to a Beef Cattle Farm.—When the class goes to a beef cattle farm for the grading of lots of animals for the purpose of marketing, feeding, etc., they should all be given active practice in every step of the work. An owner of a herd which needs grading and dividing in the fall after the stock have been brought in from grazing can often be found. He may be willing and anxious to have the assistance of the instructor and students in this work. This is more important to him when there are large numbers of animals. The students and owner should be instructed in the different grades which should be made. Examples of each grade can be selected and separated for brief study. This preliminary work should then be followed by abundant rapid practice by all members of the class. After the grouping has been completed and the animals well sorted for the winter, the exercise may be followed by making plans for the proper care and management of each lot of cattle. Students may be given exercises in judging weights and in actually weighing those to be sold.

FIG. 214.—In a region where there are good breeds of livestock, students and farmers may be given practice in examining and judging them. The school need not own them if home project methods are followed. (A. M. Field.)

Other Lessons on Beef Cattle Farms.—When students go to beef cattle farms they may have exercises and study in a number of things of value to themselves, to the owner, and usually of value to both: The marking of pedigreed stock; the making up of sale lists for auction sales; the preparing of pure-bred animals for fairs and sales, as clipping, washing, grooming, dressing horns, and preparing feed rations; the dehorning and castration of animals; the branding of cattle before going on to ranches in the spring; the vaccination for black-leg; the making of racks and other appliances for feeding and care of beef cattle.

An Extension Lesson on a Horse Farm.—Suppose the class is taken to a farm where pure-bred horses are raised. The owner will usually be glad to have the students come and may be able to glean a few points from the lesson himself. Students may be given an abundance of practice in judging and selecting animals on the farm (Fig. 214). Colts, brood mares, and sires may be first judged by score cards, then they may be compared with each other in groups of the same age. Let students have practice in discovering and pointing out weak points and strong points of all the different animals. Features which go to make up types should be studied carefully and all students induced to drill upon all the animals found on the farm. Make special drills and practice to make students skilful in finding unsoundnesses, blemishes and defects. Drill in determining the ages of animals. They should all study gaits until they become somewhat expert in the detection of different gaits and judging of animals concerning their gaits.

Other Lessons on Horse and Mule Farms.—When students go to places in the community they may make special studies of any of the following points: The management of work animals brought in from plantation work in hot or cold weather; the management of harnesses and implements or vehicles where many animals are worked; the problems of proper feeding, watering, and grooming on farms where a number of drivers are engaged; the problems of grading and feeding a number of young animals that are to be kept over winter; the special problems of feeding animals for sales; the special problems of feeding mules and other work teams for exhibition; the planning of interior of barns and stalls; the care, management and feeding of breeding animals, both male and female.

When students visit farms for any of these studies, the practices of owners should be discussed. Score cards can be used by which successes in different operations may be rated. The students should be given practice so far as possible in operations which will make them more skilful.

Diseases of Animals.—Many schools with agricultural departments, located in regions where veterinarians are either scarce or kindly disposed towards the school work, find it possible to aid farmers in preventing or treating nearly all classes of common diseases of farm animals. Students who are capable and who have had practice in the work are sent to various farms when called

in many cases, and when the whole class need to be instructed they all go to the farm for the lesson. The farmer himself, if uninformed, should always be instructed and required to take part in the treatment so that he need not call for the same kind of help a second time.

A Lesson in Orchard Pruning.—When some farmer in the region needs help in learning to prune his home orchard properly, the class may go to his farm for practice. Be sure that the owner and his laborers are at home, as they should all receive the instruction while the class is getting practice in pruning. After the first preliminary lesson regarding how to prune and what to prune have been reviewed, the students and owner should each be set to work in practicing these methods. The instructor should go among them frequently and rapidly to avoid as many mistakes as possible. Pruners will often be in doubt just what to cut, and the instructor's decision will have to be rendered. Teach them all as soon as possible to make decisions for themselves and to work as if they were alone and the trees were their own.

If future pruning trips are to be made, let different kinds and different ages of trees be selected for the purpose. Neighbors should be invited to be present and participate in pruning demonstrations and exercises. If different trips are then taken in different directions from the school the people in several neighborhoods will be given opportunity to learn pruning methods.

Spraying and Other Lessons with Fruits.—Many owners of home orchards fail to study the subject of combating insects and diseases enough to properly protect their own fruit. The fruit class may go to the orchards in different neighborhoods to spray for enemies which should be fought in the winter. They may go to still others for subsequent spraying work. The student will thus get practice in making up spraying materials for different pests and for different seasons. They should learn to handle different kinds of spray apparatus. Perhaps some of the spraying outfits will be owned by the farmers, and in some cases the school equipment will be used. Let farmers be urged to provide their own equipment, which may be selected for them by the school.

Give the students, owners, and neighbors instruction and practice in fighting borers, combating mice and rabbits.

At marketing time the fruit class may go to various orchards for practice in picking, sorting, packing, and storing or marketing fruit. Community demonstrations should be made on all of these

occasions so as to extend widely the best practices. The school may also conduct projects in utilization of waste products by canning, making preserves, drying, making cider and other juices.

Exercises in Budding.—If stocks have been started in the spring by farmers or by nurserymen living near the school, let members of the class have practice in the early fall in budding such fruits as peaches, plums, cherries, and apples.

Starting Orchards.—If it is found that some one in the region is planning to set out a young orchard, the school may go to his assistance. One trip may be made to lay off the orchard, stake places for trees, and perhaps dig holes in the proper place with the use of planting boards for the future placing of trees. On another day let students, owners, and neighbors have practice in planting trees properly. They should learn to prune roots and tops before planting.

Landscape Garden Practice.—After the school has had practice in planting shrubbery, starting lawns, and planting vines and trees about the school, there may be need for practice at a few other places, provided grounds, church yards, and farm homes may be used for such work. Students should each be expected to make drawings showing plans for planting and showing what changes should be made in the lay-out. Owners should be expected to supply the trees, shrubs, vines, and seeds for the work. They should also take active part by the removal of rubbish, hauling good soil where needed, supplying manure, providing water if needed, and by taking part in the planting. Some classes have been successful in having good community gatherings on such occasions. All people of the community are thus given a chance to learn the principles of landscape gardening, and to see one good example of putting these points to use. (See again the suggestions given in the chapter on horticulture.)

Community Lessons in Home Gardens.—When people want help from the school in gardening subjects, individual students or the whole class may be given practice while helping them. Some of the special lessons which are often given by schools to farmers and other families and neighbors are here mentioned: The making of hotbeds and coldframes and the starting of these in the spring; the making of compost heaps; the laying out and planning of home gardens; new methods of staking and trellising; combating insects and diseases; the preparing of special products for marketing; the treating of Irish potatoes to prevent scab disease; the

installing of irrigation systems; the planning and starting of systems of succession and companion cropping.

New Plants for Farms.—If the school has shown that certain new plants are successful in that region by growing them on the school grounds, they should soon be introduced on many of the surrounding farms. For example, if soybeans, alfalfa, rape, or other crops are not grown in the vicinity but should be grown, give demonstrations in how to start these crops. Arrange with some farmer to grow one or more of these crops at home. Have the ground prepared according to directions in advance. Let the

FIG. 215.—A group of agriculture students of the Santa Rosa High School visited the experimental grounds of Luther Burbank and were favored with a two-hour demonstration and lecture on plant production. Center: Luther Burbank and county agricultural director. (C. L. Hampton.)

class and neighbors be present for the final planting of the crop and for the performance of any special steps needed in starting the crop, as liming, inoculation, and special fertilizing. On such an occasion let members of the class be ready to give to the community meeting short talks from the charts touching upon different phases of the management of the new crop. Plant breeding or any new productions in the region may be made the object of trips (Fig. 215).

Work in Terracing and Land Drainage.—Students should take leveling instruments from the school to farms where the owners wish to establish terraces or install drainage systems. After the preliminary surveys have been made and the owner and school have agreed on the plans, the farmer may be advised regarding

the details of procedure. The members of the class may or may not take part in the future steps. They should, however, be expected to watch the work as it progresses. If the work in terracing is not satisfactory, they should do some work that will serve as a good example.

The steps in drainage should be followed closely. After the ditch is dug students should verify closely the grades of the bottom of the ditch before tile is laid. Members of the class and owner should have practice in laying tile carefully. The installing of sediment basins, the structure of branches, the starting of heads and finishing of outlets are important elements for practice.

Lessons with Soils and Tillage of Soils.—Members of the class or all of them in company with the instructor should visit farms at various times and may give a number of important lessons to people of the community regarding soils and their management. Teach how to detect the amount of humus, amount of moisture, proportion of sand and clay, and how to take soil samples. Demonstrations should be given on farms of implements which are not commonly in use in the region—new forms of rollers, new forms of cultivators, new kinds of diggers and planters; use of tractors, the importance of harrowing after use of smooth rollers, the use of subsoiling plows, and any others that become available.

Community Work in Farm Mechanics.—When students have learned some of the special lessons in farm mechanics necessary for certain farm projects, they may be able to find suitable farms for trying their hands under the guidance of a good instructor. The following fields of work are suggested from which selection may be made: Install water-pressure systems. Install pumping fixtures. Build septic tanks and install sewerage systems. Install farm lighting systems. Install stationary engines and machinery and shafting. Make concrete walks, or floors, or do other concrete work. Help frame farm structures and oversee the other steps in the building. Install modern fences and improved gates.

Give demonstrations in use of road drags. Give object lessons to farmers in rope splicing. Students may build bird houses and erect them about their homes or about the homes of willing neighbors. They should have practice in painting buildings and in whitewashing others. A few such lessons on badly run down farms may induce owners to improve their premises in other ways and thus the whole neighborhood will be benefited.

Coöperation with Other Schools.—County high schools and village or city schools with agricultural departments should coöper-

ate with smaller schools in the region for the teaching of agriculture. In some cases the instructor of agriculture is employed to give a part of his time each week or each month in instructing the teachers of smaller schools in special subjects, such as gardening, dairying, and poultry raising. By this means the teachers so instructed are able to conduct suitable exercises in their own schools. Suitable bulletins may be furnished to these teachers.

Plans for the beautifying of rural school grounds may be made for

FIG. 216.—School exhibits of agricultural products may be supplemented by shop work, maps, pictures, charts, plant specimens, insect collections, and cut flowers. (School Garden Association of America.)

each of the schools by students in high school departments. The teachers should then be instructed how to secure the plants and how to plant them according to the plans furnished. These plans should be framed and kept in the rural schools for future guidance of all.

Kits of simple apparatus are sometimes put up by the central school for use in the other schools. Specimens for practice in judging grains, grasses, and corn may likewise be provided by the agricultural department from its farm or land laboratory.

Community Fairs.—At least once a year all agricultural districts should hold a good community fair. The school should take an active part in this, and perhaps the instructor of agriculture

should be the main leader in starting the movement for a good fair. A few discussions may be started among the students regarding the value of such fairs, materials for them, suitable places, premium lists and premiums.

This early discussion should be followed by the calling of a few community leaders together, or by having the subject discussed by them or by students at a regular meeting of some community club. Committees may be appointed by this club or by the special meeting to consider each of the foregoing points and report at a future meeting. Later these same committees may be appointed to raise donations for premiums or make plans by which premiums may be raised. Perhaps a charge for admission to the fair will provide for premiums. In some cases no premiums other than ribbons are offered.

FIG. 217.—Thanksgiving exhibit by students in vocational agriculture, held in the community church. (G. S. Boggan, Ark.)

If conditions are favorable for the fair at the school, the first fair may include all kinds of farm products (Figs. 216, 217, and 218) except the large livestock, and at future fairs include these also. Judging of products at community fairs should be unofficially done by all students studying agriculture. This gives them good practice which cannot be easily secured in the same length of time elsewhere. The official judging, however, should be in charge of some competent judge engaged for the purpose from another school or from another community. Use the fair in trying to standardize the leading varieties of important crops (Fig. 219).

Instruction Booths at Community and County Fairs.—The department of agriculture of the school should see to it that several or many booths are installed at community fairs, county fairs,

and perhaps at state fairs where agricultural operations of many kinds are continually carried on during the day or days of the

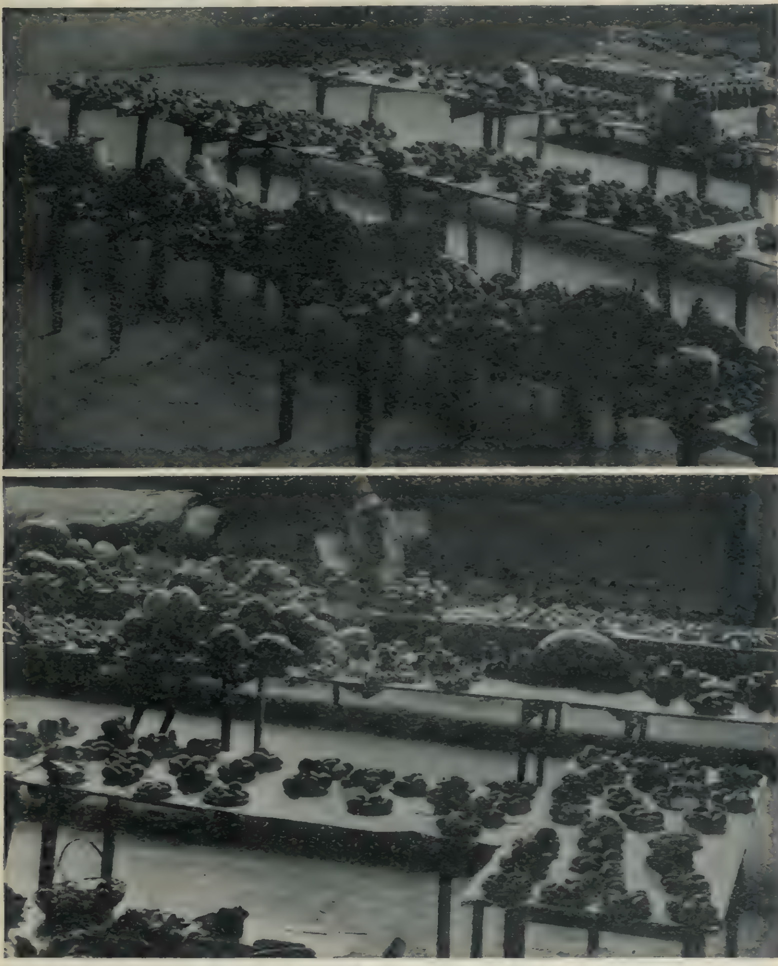

FIG. 218.—At fairs, the products should be classified according to the premium list. Have superintendents appointed who will classify the exhibits as they are brought to the fair. (G. S. Ellis, Minn.)

fair (Figs. 220 and 221). A few of the activities for such booths are mentioned here:

1. Have some one testing milk and milk products, and decorate the booth with dairy charts, dairy pictures, and dairy equipment.

2. Have a booth for the making of spray materials; decorate with fruit charts, colored pictures, specimens of insects and disease work.

3. Have a feeds booth. Have feeds mixed at certain hours for poultry, dairy cows, dairy calves, and other animals. Decorate with samples of feeds, feed charts, including both concentrates and roughage.

4. Have a honey booth with some one extracting honey at particular hours. Decorate with samples of extracted honey, comb honey, bee diseases, bees' wax, foundation, and bee equipment. Have hives of bees in glass frames.

5. Have another booth showing the grafting and budding of trees. Decorate with charts and pictures of nursery work and home orchards.

6. A booth should be occupied with one or two persons wrapping and packing apples in boxes. A grading and sorting table may be in the booth. Decorate with large pictures showing different styles of packing, and with charts showing market grades, and market prices.

7. Have one booth devoted to legumes. Show specimens, pictures, and charts of all the leading legumes suited to the region. Have specimens of lime of different kinds. Have charts calling attention to the benefits of legumes, and others showing steps in establishing certain crops. Let some one in the booth be treating legume seeds and soils to inoculate with bacteria. Specimens of roots in large glass bottles in two per cent formalin water should show nodules of many kinds of legumes.

8. A seed-testing booth may show the steps in testing seeds by different methods, including corn testing as well as other kinds of seeds. A few charts should call attention to the benefits of testing, to the money saved, and to the cost. Decorate with many pictures of successful farms. Seed selection and seed treating may be included here or shown separately.

9. A poultry booth may have some one calling attention to the methods of culling laying hens to get rid of the drones. Another person may be candling eggs and showing people how to do it. Have in the booth grades of eggs nicely arranged in market cartons. Show methods of packing eggs, kinds of egg cases. Have a chart showing how to feed for egg production; another on producing infertile eggs, and others on the importance of egg production.

10. If desired, another poultry booth may have chicks with an attendant showing how to successfully raise incubator chicks. Line the booth with charts giving directions for feeding, temperature, increase in weights, comparison of breeds, and numbers raised by artificial and natural methods.

Harvest Picnics or Fall Festivals.—In the latter part of the summer or early fall, farming communities should hold picnics, and have programs suited to their vocation. Agricultural plays may be presented by young people.[2] Demonstrations may be given on making lime-sulfur, making Bordeaux mixture, making dry mash for poultry, and doing many other agricultural things which would be of interest to all. Let ten or twenty of these things be definitely planned and practiced by students, or others assigned to the topics. This kind of program will interest the people much more than political speeches or other set speeches from a platform.

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[2] A few agricultural plays have been issued as Minn. Ext. Bulletins. Write to the U. S. Bu. of Ed. for gardening play.

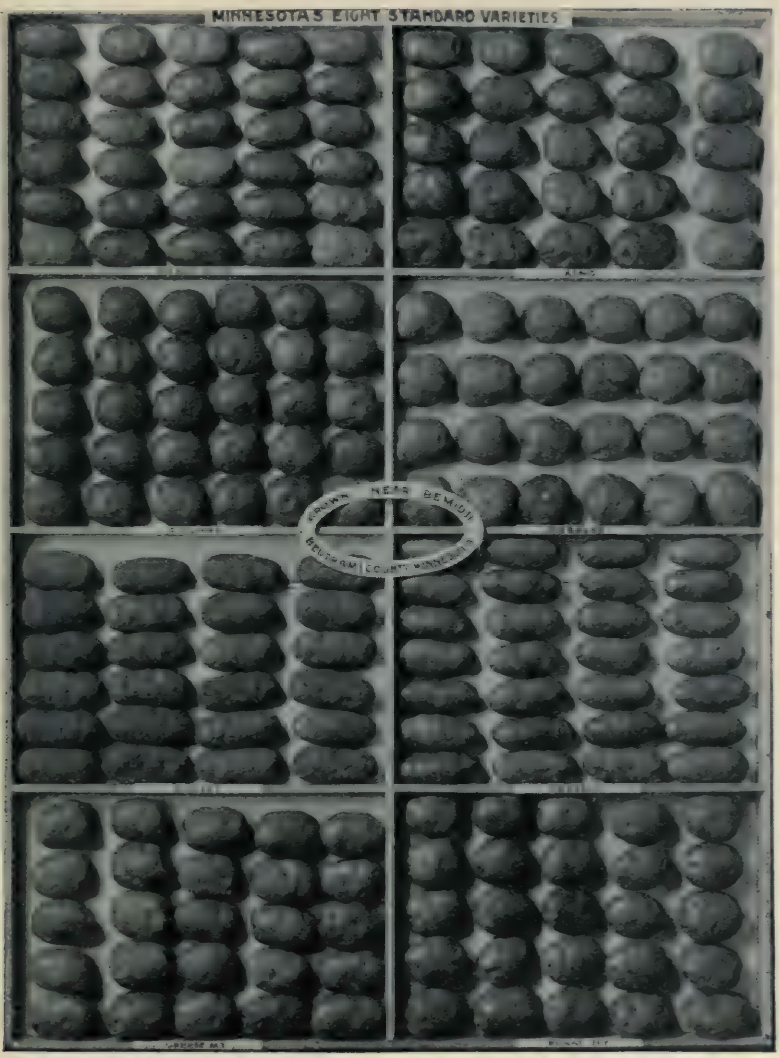

FIG. 219.—The instructor in agriculture, through the fairs and the work of his students, should standardize the products of the region. Here are eight standard varieties selected from the local fair according to variety characteristics. Left column: Early Ohio, Triumph, Russet, Green Mountain. Right column: King, Cobbler, Burbank, Rural New Yorker. (B. M. Gile, Minn.)

Graduating Exercises of Students in Agriculture.—There are many practical and useful topics which would interest the people

who attend commencement exercises in rural districts or in cities supported largely by the surrounding farms. Let students graduating from the agricultural department take part in the graduating exercises. Each student may be allowed to use five or ten

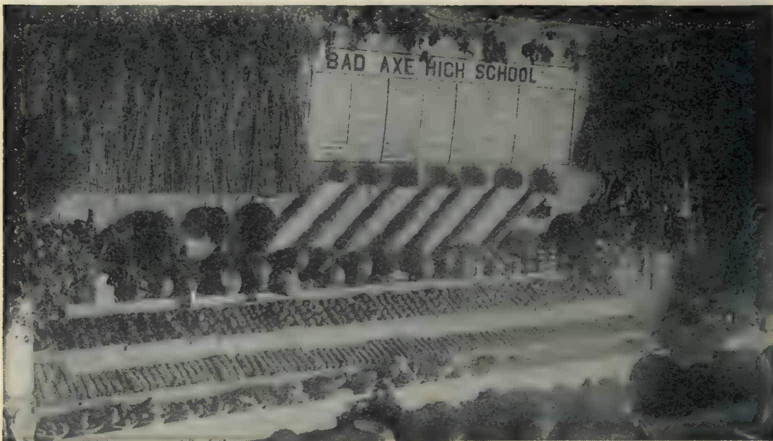

FIG. 220.—Agricultural exhibit at county fair. The course of study is given a conspicuous place. (Wm. C. Brown.)

FIG. 221.—Models of schools make good features at fairs. Left, the background of the exhibit is a reproduction of the front of the school building, and a silver cup was awarded. (H. N. Loomis, Mass.) Right, model of the grounds and buildings of consolidated school, awarded a prize at the Panama-Pacific Exposition. (Fred Grafelman.)

minutes for the presentation of one topic well prepared in advance. He should have the necessary apparatus and illustrative material to make a brief demonstration showing a valuable lesson in agriculture. His discussion should be informal after careful preparation.

A feature of the closing week may be a school play[3] or a school pageant (Fig. 222).

Topics for Agricultural Commencement Exercises.—The topics

FIG. 222.—"The old and the new" in agriculture and home life may be used as a street pageant on commencement day. The above are two glimpses of "the old"—the old-fashioned wooden hay rake, and the ox team followed by the hand cradle for cutting wheat. (Angeline Wood, Alfred, N. Y.)

suggested here are taken from programs which have been rendered on such occasions by high school graduates.

1. The making of "Self-boiled Lime-sulfur." The student may have the lime, sulfur, water, and necessary utensils. He should start the lime to slacking just before he is called upon for his part of the program. This is brought in by an assistant. Then he takes the sulfur, making his discussion as he goes along. He may tell something of the uses of lime-sulfur and how much is saved by making the material at home.

2. "Making Bordeaux Mixture." The student may start with the two stock solutions, lime and blue vitriol. He may show how to dilute each of the

[3] Write to Univ. of Minn., Ext. Div., for play "Back to the Farm"; to Cornell Univ. for Lesson 153, Country Life Series; and to N. D. Agr. College for "Public Programs," No. 122.

stock solutions and then call on an assistant to help pour these together into a third vessel, explaining as this is done. If glass vessels are used, the resulting color will show nicely throughout a large audience. He should explain how the stock solutions are made, and how they may be kept for a long period ready for use when the Bordeaux is needed. The uses of the mixture may also be included in his topic.

3. "The Home Mixing of Fertilizers." The student should give prices of several materials which he has presented, such as acid phosphate, nitrate of soda, and sulfate of potash. He should show the formula which he is striving to obtain and how much material of each of these kinds is required in the mixture to make this formula. He should actually mix the ingredients together on a large tray prepared for this purpose on the floor. This may be carried away after his number. Let him give the arguments in favor of the home mixing of fertilizers.

4. "A Lesson in Culling Poultry." Have a number of hens in a coop ready for this exercise. As the points in the culling card are enumerated by the student, he may handle the birds and explain each point briefly. If time is limited, let only the chief points be considered.

5. "The Production of Sterile Eggs." Let the student have a number of eggs present and show how they are candled. He may call attention to eggs which have developed the embryo after several days in hot weather. He should explain the appearance of each and the effects of such germs dying or growing in the egg. He may give results of trials showing that hens lay as many sterile eggs as they would if fertile. He should tell what the losses are from fertile eggs and show the saving to farmers by selling or killing the roosters in their flocks after the breeding season.

6. "The Judging of Poultry." Let one or more birds of the same or different breeds be judged before the audience according to the standard score card.

7. "Treating Oats for Smut." Have a peck or so of oats and let them be treated with formalin solution in the presence of the audience. Explanation should be given of the benefits, variation in methods, and cost.

8. "Treating Potatoes to Prevent Scab." Use the corrosive sublimate or formalin method and give the benefits. He should show scabby potatoes and tell of the serious losses from this disease.

9. "Selecting Seed Corn." Let a bushel or more of ears be ready for use in this exercise. The student may sort them over and pick out the best from the lot. He may explain the importance of selecting the corn in the field and the importance of sorting it well afterwards. Then let him run over rapidly all points considered in selecting the best.

10. "Seed Testing." This exercise may be confined to testing by the rag-doll method, the sawdust box, or any other method. There should be several lots of seeds showing different stages in the method. He may go through the process of putting seeds into the tester; then another lot to show the tester in the middle stage of its running; then another lot to show the final results of the test. The advantages of testing may be mentioned.

11. "Treating Chickens for Lice."
12. "Feeding Baby Chicks."
13. "Running an Incubator."
14. "Testing Eggs in an Incubator."
15. "Plumping Dressed Broilers or Fowls for Market."
16. "Packing Dressed Poultry in Boxes for Market."
17. "Sorting and Packing Apples or Peaches for Market."
18. "Wrapping and Packing Apples in Boxes."
19. "Grafting and Budding of Fruit Trees."
20. "Making Grafting Wax."
21. "Judging the Ages of Horses."

22. "Testing of Milk."
23. "Pruning Young Fruit Trees."
24. "A Lesson in Pruning Old Trees."
25. "Liming of Soils."
26. "Inoculation of Legume Seeds."
27. "The Feet of a Horse."

Farmers' Institutes.—Local farmers' meetings and perhaps those of more general scope should be planned by the agricultural department in high schools, consolidated schools, and by local rural schools. Probably the least that can be expected from even the smaller rural schools is to have a few farmers' meetings planned for the winter season.

High schools should plan to hold a number of community meetings in different neighborhoods of the region. These may be planned to run through the winter, if not throughout the year. Programs for these meetings should be planned by the agricultural school working in unison with committee members in each of the communities.

Organizing for Farmers' Institute Work.—Let each of the communities be organized into a community club, Chautauqua Associations, or any name which they may desire to use. Sometimes these are branches of local units, of state granges, or of farmers' unions.

The agricultural teacher and his students should work among these neighborhood organizations. They may appear on the program from time to time, but most of the work on the program should be by the local people themselves. Endeavor to teach people how to conduct their own programs without assistance from the school. Do not allow them to make up programs of long set speeches. It is better to have the programs filled with discussions in the form of round tables. Have demonstrations given by farmers who can show how they have done certain things. Try to discover people in the region who can tell how they have done certain things on their farms. These may be placed on programs in other communities until they make the rounds. For example, if one man is successful in growing strawberries by a certain method, let him explain to one of the communities how he does it. The instructor may question him and bring out many points in the discussion which would otherwise be omitted and will incidentally be coaching him for a better presentation next time. This member will later appear on other community programs with the same subject. Another farmer may have been very successful in

the management of market garden crops, and is induced to appear on one or more programs of the winter.

The writer has coached many farmers to prepare some one topic very well and present it at local farmers' institutes. Bulletins were placed in their hands to aid them in formulating their thoughts on the subject with which they had had much experience. The people are always better satisfied with talks and demonstrations by real farmers than they are with discussions from others. Six or eight topics presented by as many good farmers, and each taken to a number of neighborhoods will make a good winter's program for a whole county.

Rural Leadership.—Each of the farmers who has been trained as were those before described will become a community leader. He has been made to face audiences enough to be willing to speak to his own people. He has seen the backward characteristics of people in other communities and will try to meet such defects. He may be willing to aid in bringing out other neighbors who have succeeded in certain kinds of farming.

Let students of the school be induced to select suitable leaders from the community. They can also by questioning help to develop certain topics in the minds of men who have made successes in other farm operations. In other words, they may help train local speakers by showing them that they know enough to present their methods of doing things. They can put the proper bulletins into the hands of those who are to appear on the programs. They can act on program committees. They can be taught to run lantern slides or moving picture machines for use in their own neighborhood and in others.

Short Courses at Agricultural Schools.—High school departments of agriculture or special agricultural schools should from time to time, or at regular intervals, plan and announce short courses for farmers of the region. These short courses may be devoted to special topics, as: (1) Poultry, (2) gardening, (3) fruit growing, (4) dairying, (5) bee-keeping, (6) apple packing, (7) field crops, (8) corn, (9) potatoes, (10) swine, (11) beef production, (12) sheep.

The length of such short courses varies from one week to several weeks. One of the chief factors in determining the length of any short course is the amount of assistance which the instructor is able to secure for the work. He may in some cases be able to use farmers of the region or from other sections of the state or county,

with or without compensation. Specialists from colleges and departments of agriculture elsewhere are sometimes engaged. His own students are often used in giving special demonstrations, as in judging corn, making spray mixtures, mixing feeds and fertilizers, and culling and judging stock. If students are used in such exercises during the week or two, while the short course is in progress, they may gain sufficient training to amply compensate for loss of class work during the time.

Read again the suggestions regarding short-course work in Chapters V to XII.

Boys' Agricultural Camps.—During the summer season some agricultural departments and schools have conducted boys' camps at appropriate places in their counties. The encampments are made for a few days or for a week or two at a time. Certain hours of the day are set for reports and accounts of the project work of the students. Prospective students are invited to participate in the encampment. If the time is near the end of the vacation season, results of projects may be given. Much of the time at the encampment is used in recreation, contests, games, story telling, reading, and other entertainment. Perhaps the environment will furnish some opportunity for swimming, fishing, and other water sports. In many cases such encampments are held on the grounds of the local fair association, or in public parks, or in picnic groves, or on the private grounds of some farmer.

The Boy Scout spirit should pervade all the elements which go to make up a successful boys' agricultural camp meeting. Read over requirements for Boy Scout work, the pledge, and the standard. Then try to maintain this high ideal. If the right spirit is not secured, the boys' camp may be worse than useless. Good leadership counts for much in their success.

Coöperative Farmers' Organizations.—Instructors in agriculture often find it their duty to outline plans for coöperative endeavor among farmers. They should be able to explain the advantages of such organizations for various enterprises. They should also be able to point out the dangers which will confront them. They should be able to formulate plans; tell how various organizations have proceeded; tell how capital is apportioned among members; give constitution and by-laws; describe duties of certain officials and explain the division of responsibility. Students preparing to lead farmers in such matters should read accounts of the work of coöperative organizations of other kinds. They should visit as

many of these as possible and consult with officials regarding the details of their work. They should send for copies of constitutions and by-laws. They should study both successes and failures.

Among the coöperative enterprises of farmers should be mentioned butter factories, milk depots, cheese factories, potato marketing, fruit marketing, onion and other produce marketing, nut marketing, laundries, ice plants, lighting plants, bakeries, marketing of poultry products, ownership of pure-bred sires of any class of animals, ownership of farm engines or other machinery, purchasing coal, seed, tools, feed, and household supplies.

Farm Demonstrations.—The agricultural departments of schools often conduct farm demonstrations on farms of the region. These demonstrations may consist of growing some new crop as it should be grown, growing some old crop in a better way, the feeding or care of animals more successfully, the maintenance of a dirt road, the improvement of a farm, or any other activity which falls within the scope of the school work. Such demonstrations may be given on the farms of students who attend the school or upon other farms which the instructor can easily visit while on his trips doing other work in the community.

Agricultural demonstration work is so well known that its benefits need not be mentioned here. Community meetings should be called to visit the farms where these demonstrations are conducted. These meetings may be held either during the progress of the demonstration or near its close. Some special inducement should be suggested when neighbors are called to such meetings. The call should be worded carefully. Perhaps some product of the demonstration may be offered to each visitor—samples of seed, samples of tubers, samples of hay or other crops. Refreshments may be offered or a community picnic may be held at the place. An attractive program may induce them to come.

Agricultural Campaigns in the Region.—Recently the American people have learned to accomplish many things by brief intense public movements. The agricultural instructor may find it possible to succeed in starting reforms among the farmers of his region by selecting a few features and making campaigns on these until all farmers have learned the new methods involved and perhaps have succeeded well with them. A few that have been used by agricultural teachers are here mentioned.

In a dairy region each dairyman was induced to grow two acres or more of alfalfa. A better seed corn campaign reformed

the corn growing of one district. Every farmer was induced to try better seed corn on all or part of his field. A liming campaign became very popular in a region where clover growing had become nearly extinct. In a number of cases milk-increase has been the slogan among dairy farmers. They have in many cases formed coöperative creameries. Peach planting and apple planting campaigns have been organized with great success. Coöperative fruit growers' associations often help in such campaigns.

In a number of counties campaigns have been pushed for the growing of pure-bred poultry. These are often started among children of rural schools, and then are taken up by older people. "Better brood mares and more brood mares" formed the slogan in regions where farmers were formerly buying their work horses from outside. Better beef sires have been introduced in a number of regions through the organization of farmers for that purpose. "Better dairy heifers" is a good slogan to help induce dairymen to use better sires. Agricultural instructors should plan campaigns to suit the region. In addition to those already suggested a few others are proposed: A trial of cross harrowing of corn on every farm; field selection of seed by every grower of cotton, corn, or other important field crop; a septic tank on at least one farm of every neighborhood; modern water systems on ten farms; a pure-bred boar available to every farm; better marketing of farm products of all kinds. Leaders of such movements should enlist the aid of local organizations and of special committees.

The Use of the Press.[4]—Schools teaching agriculture should make good use of the local press of the region. Newspapers that circulate among farmers should devote considerable space each issue to agricultural topics. The school can aid materially in supplying suitable matter for publication in local papers, in large dailies of the nearest cities which often have agricultural departments. The school can make the preparation of articles for publication a part of the school work.

Reasons for Using the Press.—Any teacher of agriculture should study his local conditions and see if any of the following reasons or others can apply. If he can find a good reason for making use of the local press, he should go to the publisher or editor of one or more of the papers in his locality or those in near by places. Give them arguments for using agricultural matter from time to time. If the editor is willing to use suitable material,

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[4] See also Chapter XVI, p. 332.

the school should offer to help supply it. Among the reasons which may be in the teacher's mind are the following:

1. Articles regarding modern agriculture will always help farmers to be more interested and more successful in their work.

2. Information regarding special operations which ought to be carried on by the farmers of the region can be brought to their attention through the press, particularly if farmers get in the habit of looking to the press for agricultural suggestions. These may be seasonal suggestions, as the starting of hotbeds, the protection of fruit blossoms from frost, the culling of the pullets for future laying flocks, the preparation of winter quarters for laying hens, the breeding season for hot-house lambs.

3. Agricultural campaigns of various kinds can be conducted much better by the use of the press.

4. The accomplishments of coöperative efforts are more successful if the press aids in conducting them. For example, more farmers can be induced to raise certain crops if they are assured of a fine market for these crops before they are planted. The promotion of canneries and the growing of crops for such canneries is an example of this.

5. The promotion of coöperative associations for marketing various kinds of farm products is more easily accomplished when much publicity is given the movement.

6. The school work which should be one of the leading endeavors of any community may be kept in the minds of the people better by the use of the press.

7. The successes of individual farmers who have been progressive in special types of farming may be spread to other farms of the region by means of such publicity.

8. The demonstrations conducted on farms of the region may be announced and kept in the minds of the public so that they will more closely watch the progress and results of the work.

9. The successful home projects of individual students should be given publicity.

10. Farmers who as a class are lonely in their agricultural thought are induced to read much more agricultural matter if it is brought to them regularly in their home papers.

11. Farmers are induced to keep in touch with things that other farmers are doing.

12. They get new ideas of up-to-date methods.

13. If publishers run agricultural departments, they will find it possible to publish also reliable advertisements of implements, fertilizers, feed, stock, and poultry.

14. Farmers may be warned against fraudulent schemes of unscrupulous agents.

15. The papers may be used to announce agricultural meetings, stock fairs, and other community gatherings.

16. Farmers may get reports of experiments of many experiment stations, and will learn of the publication of new bulletins and other literature for farmers.

Kinds of Material which the School can Furnish the Press.—In reading over the foregoing reasons for publishing agricultural matter in the press, any one may naturally infer what kinds of material may be supplied to the press by the school. It may be

worth while here to mention a number of the most important kinds of matter which the school can easily prepare for publication.

1. Occasional reports of experiments or demonstrations conducted by students and instructors on the school grounds or in laboratory work.

2. Announcements of programs of daily work, of special exercises, of short courses, of farmers' institutes, of boys and girls' club work, of programs of literary societies in school, of graduating exercises of agricultural classes.

3. Students can prepare articles on special topics for publication, and will do it better than if they are to be consigned to a waste-basket. This may be for credit in English or in agriculture.

4. Complete final reports of projects may be chosen for publication.

5. Finanacial statements showing cost of production in home projects.

6. The best reports written by students of field trips or visits to neighboring farms, of visits to packing houses, cold storage plants, fertilizer factories, feed mills, implement establishments, tractor demonstrations.

7. Accounts written by students of special operations on their farms, as the description of the filling of a silo, including the detailed items of cost. Another example would be an account of the methods and cost of harvesting a crop of any kind, as potatoes, or apples.

8. At the beginning of the year, let a complete list of all the projects started by students on their home places be published.

9. From time to time give a report of the progress of each of the projects of students.

10. Publish lists of demonstrations in progress on farms of the region, if these are under the supervision of the instructor or some other agent.

11. Call attention to particular new crops on various farms so that others can see their growth and learn methods of producing them.

12. The school may serve as a central bureau of information and each student may write items of interest regarding valuable points in farming which occur on their own farms or those of neighbors. Thus many items of local interest that are worthy of emulation will come to the public eye—the building of good barns, the improvement of home grounds, the starting of new methods, the purchasing of pure-bred cattle or other livestock, the production of more dairy products, the high records in poultry yards, the fine yields of certain fields. the securing of better prices for produce.

13. Students and instructors may write reports of fairs, giving winners of premiums in all departments of agriculture. Describe booths. Describe products shown at fairs. Make lists of exhibits in various departments. Praise the best things seen there.

Illustrations for the Press.[5]—The instructor, or some of his students with a camera, may obtain many valuable illustrations from the farms of the region which may be used to illustrate the foregoing matter. Many publishers are glad to make use of illustrations in connection with the matter furnished them. Take pictures of operations at school showing the work of students in laboratories, the growing of crops, or the practice work on the land laboratory of the school. When the class is taken to various farms of the region as suggested in a number of places of this volume, photographs may be taken of farm operations, of valuable stock,

[5] See also Chapter XVI.

of classes in various exercises on these farms, of good silos, barns, dairy houses, poultry yards, good machinery at work, good roads, well-kept yards, and many other views.

Such views will speak louder than words. Many papers, even those of a local nature, often circulate widely in other regions. The pictures, with suitable reading matter accompanying them, will attract attention to agricultural enterprises at home. The whole region will thus be benefited by the use of good pictures.

In connection with special articles and some of the other matter furnished for publication, students may prepare charts showing statistics in graphic form. They may make drawings of simple buildings showing how to build them. Simple farm devices and apparatus may be easily illustrated by simple drawings. The structure of septic tanks, the installation of irrigation systems, the contour line in field terracing all furnish subjects for drawings.

Characteristics of Good Newspaper Articles.—It is important that instructors having students writing matter for publication should teach them to remember that writings are to be scrutinized by the public eye, and that they must strive to be as perfect as possible in expression and not try to exhibit characteristics which would be open to criticism. Let the following points be kept uppermost in their minds:

Make the language simple and plain without the use of many unusual terms. In the choice of words, use the short simple Anglo-Saxon rather than long or complex words.

Avoid long complex or otherwise involved sentences. Do not try to be flowery. Simple, plain statements are good English.

Make short paragraphs rather than long ones. Let each idea be expressed briefly, and if it needs repeating, do this as adroitly as possible.

Tell many things to the reader without seeming to tell anything. This can be done by assuming that some few need reminding of certain things that the writer states.

Prepare short articles rather than long ones. A long article often fails in securing many readers.

Never prepare articles for publication on agricultural topics unless they are suited to the season, or have some seasonal aspect. An article on care of sheep at lambing time should appear before that time instead of after it.

Use good headings. Always write the headings instead of leaving it for the editor to do. Study the style of the type used

by the paper which is to publish the article. Use the proper underlines of the headings to show the style you expect to have used. If the paper uses center headings in the articles for sub-headings, follow that style in preparing the article. If side headings are printed by the paper, prepare your article with side headings instead of center headings. Use a number of these sub-headings for the different paragraphs or some of them. This is most important for the longer articles.

When students prepare important articles on special topics their names should usually be published with them. There are two styles used for this. See which of these is usually followed by your paper. Is the name of the writer placed under the main heading of the article or is it placed at the close of the article? The first is preferable if the editor will allow it.

Never allow students to offer for publication matter which has not been read and criticized by the teacher of agriculture, or the teacher of English, or both.

Avoid silly allusions to local school happenings which will not be understood clearly and fully by the public at large. Avoid efforts at "smartness" by students in writing for the public press. Nothing will hurt the school more in the eyes of a tax-paying public than this.

School Papers.—Colleges of agriculture, and perhaps other colleges having agricultural departments, often find it advisable to publish periodicals of an agricultural nature. Much of what has been said in the preceding pages applies to matter in these periodicals.

There are two types of such school or college publications found: those which are purely of an educational nature and contain no advertising material. These are issued under the act of Congress of July 16, 1894. They must be published at least four times a year, and are not required to have a list of paid subscribers.

The other form of publication is issued under the law governing newspapers and magazines. They contain advertising matter and are required to have a list of paid subscribers.

The mailing rates for these publications are the same, *i.e.*, one cent per pound. This is known as second-class mail matter. Regulations regarding either of these types of publication may be obtained from the nearest post-office.

High School Publications.—When high schools find it impossible to make good use of the local press of the region they some-

times start school periodicals. These are sometimes published in mimeograph form and distributed to the students and their families at a nominal cost. In other cases they are printed and advertisements are solicited to help meet the expenses of publication. In villages and small cities the burden upon advertisers is usually a heavy one, and the resulting effect among business men is not a wholesome one. If the school is very large and a very worthy publication is issued to a large list of subscribers, the advertising is really worth while and the effect of issuing the paper is a good one.

A common defect of high-school papers is that they often have unwholesome and objectionable features such as mean, silly, or opprobrious allusions to students, teachers, occurrences at school or in the community. These are not worthy of publication. The paper in printing them debases itself and should not continue to use its columns for such trash. Such things waste the time of students who read them as well as those who write them. Another common objection to issuing periodicals managed by high school students is that they are required to use much of their time in making the publication pay for itself. Committees are required to solicit subscriptions, solicit advertisements, mail copies to subscribers, and maintain departments which are of little use in the field of agriculture or in other departments of education.

EXERCISES

1. Make a plan for a social room for the community to use at the agricultural school, or high school. List its equipment.
2. Make plans for a good shed or barn where animals from the community may be temporarily cared for at the school, while they are being studied by classes. Give equipment necessary for such quarters.
3. Make a list of ten kinds of trips which agricultural students in your state could take to make use of the community in their school work.
4. Outline a trip near your school for an exercise in treating swine for cholera.
5. Describe the details of an extension trip in the study of sheep at lambing time.
6. Outline a community trip for studying hogs which have died from cholera. Include post-mortem examinations.
7. Outline a half-day's exercise for your class in planning and beautifying the home grounds of a neighboring farm.
8. Outline a plan for coöperating with rural schools near you, to aid them in their agricultural work.
9. Write a premium list for a small community fair.
10. Participate in soliciting premiums for a community fair.
11. Erect a model instruction booth for a community fair. This may be done either at the school or elsewhere.
12. Plan the details of at least three topics for the agricultural commencement.

13. Write a program for a model farmers' institute, with sections for men and women, to cover three sessions, forenoon, afternoon, and evening.

14. Write a program for a fruit growers' short course, covering three days; another for dairying; another for bee-keeping; another for animal husbandry; another for poultry.

15. Obtain, or write, a constitution and by-laws for use of a coöperative farmers' organization of some kind.

16. Plan the details of some important agricultural campaign, for your region. Tell how you would obtain workers and prepare suitable outlines for their guidance in the campaign.

17. Prepare a model article for use in the local paper which will be of benefit both to your school and to the community. Have your article published in the paper.

18. Prepare a similar article with illustrations and have it published likewise.

19. Prepare a list of many ways in which your students can help in farmers' institutes, short courses, and community club work.

QUESTIONS

1. Why should the school and the community be closely linked together? Have you seen examples of this?
2. Give arguments in favor of a social room in the school.
3. How would you plan to test seed corn for the farmers of the community?
4. How would you obtain ear corn from farmers for school exercises?
5. How would you obtain legume seeds from farmers to be inoculated at the school?
6. Why should the school own a seed cleaner?
7. To what extent should farmers be allowed to make use of it?
8. Would you offer to treat small grains for smut for farmers of the community? Why?
9. Would you treat potatoes to prevent scab? Why?
10. Would you undertake to have your students graft scions for farmers of the region? Why?
11. How could you manage exercises in the propagation of strawberries or other perennial herbs that are found in the community?
12. How would you arrange for a fruit-judging exercise with fruit supplied by farmers?
13. How would you take advantage of specimens of insects and their work or of plant diseases brought to your school?
14. How can you make school lessons concerning the noxious weeds of the region?
15. What machinery of your region might be repaired at the school shop with advantage to the class?
16. Why should the school aid farmers in planning their farm buildings?
17. Why should the school offer to test milk from cows of the region?
18. How would you manage the livestock of the region for use of your pupils in the school?
19. What are the two main purposes for attempting to extend the activity of the school throughout the region?
20. Give examples of poultry lessons you could teach to your students out in the community.
21. Give examples of dairying lessons you could best give to your pupils by taking them to dairy farms.
22. Give examples of similar extension work with swine.
23. Describe an extension trip for work with sheep.

24. Describe an extension trip to a beef cattle farm.
25. Give lessons to be learned on a farm where pure bred horses are raised.
26. Give list of materials that you might secure at a post-mortem examination from a horse, a sheep, a cow.
27. How would you conduct a lesson in orchard pruning, on a nearby farm?
28. In orchard spraying?
29. Suggest some community lessons in home gardening.
30. How could you help your community in landscape gardening?
31. How could you help your community in the introduction of new plants?
32. Describe a community exercise in terracing; in land drainage.
33. Suggest some other community work with soils and tillage of soils.
34. Suggest some community work in farm mechanics.
35. Why should the agricultural department of a high-school endeavor to coöperate with other small schools of the region in the community work?
36. Give reasons for holding community fairs.
37. Describe a number of educational booths for agricultural fairs.
38. Why should agriculture students give demonstrations at their commencement exercises?
39. Suggest several topics for such a program.
40. Why should the agricultural school participate in planning farmers' institutes?
41. Why should the agricultural school or department offer short courses in special lines?
42. Give reasons for aiding in forming coöperative organizations.
43. Give a list of agricultural drives, or campaigns, which would be of use in your state.
44. Give reasons why the agricultural school should use the local press.
45. Give a list of materials which the school can furnish the press.
46. Give the characteristics of good newspaper articles of this kind.
47. Give your reasons for and against starting school papers.

APPENDIX

TEXTBOOKS FOR HIGH SCHOOLS

The following books, arranged by subjects, are those which are considered most worthy of consideration for use as regular textbooks in the courses mentioned, when offered as vocational courses in high schools. As other books are published from time to time the recommended list may need to be varied. In some states uniform lists for all the schools are adopted and are to be followed. This list does not pretend to include all the reference books for these courses.

Field Crops or Plant Life, Usually First Year.—Davis' Productive Plant Husbandry; Montgomery's Productive Farm Crops; Duggar's Southern Field Crops; Wilson and Warburton's Field Crops; Livingston's Field Crop Production.

Animal Husbandry.—Harper's Animal Husbandry for Schools; Harper's Manual of Farm Animals; Plumb's Beginnings in Animal Husbandry; Tormey and Lowry's Animal Husbandry.

Dairying.—Washburn's Productive Dairy Husbandry; Eckles and Warren's Dairy Farming.

Poultry Husbandry.—Lewis' Productive Poultry Husbandry; Lewis' Poultry Keeping; Lippincott's Poultry Production.

Feeds and Feeding.—Woll's Productive Feeding of Farm Animals; Henry and Morrison's Feeds and Feeding (Abridged).

Horticulture.—Davis' Horticulture; Hood's Horticulture.

Small Fruits.—Sears' Productive Small Fruits.

Gardening.—Davis' School and Home Gardening; Lloyd Productive Vegetable Gardening; Watts' Vegetable Gardening (for trucking regions).

Soils.—Wier's Productive Soils; Whitson and Walster's Soils and Soil Fertility.

Orcharding.—Sears' Productive Orcharding; Bailey's Principles of Fruit Growing.

Farm Mechanics and Engineering.—Davidson's Farm Engineering, Ramsower's Equipment for the Farm and the Farmstead.

Farm Management.—Boss' Farm Management; Warren's Farm Management.

LIST OF BOOKS AND BULLETINS

The following State Departments of Vocational Education have issued classified lists of references and texts:

California.—Bibliography of Agricultural Reference Books (very full) (State University, Berkeley).

Iowa.—List of Bulletins and Circulars, classified by subjects (Ames).

Michigan.—Agricultural Reference Library; Textbooks (Bul. 205, List of High-school Equipment). (Lansing.)

Minnesota.—Books for Farmers and Farmers' Club Libraries; Books for Judging; Agricultural Reference Library (University Farm, St. Paul).

Nebraska.—Text and Reference Material in Vocational Agriculture (Dept. of Vocational Agriculture, Lincoln).

New York.—Suggested Reference Books for Vocational Agriculture (State Education Department, Albany).

Texas.—Required Reference Books for Vocational Agriculture (A. and M. College, Bryan).

Write to the States Relations Service, Division of Agricultural Instruction, U. S. Department of Agriculture, Washington, D. C., for lists of Texts and References for Secondary Schools. Special lists are issued upon the following topics:

General Agriculture.
Agronomy.
Animal Husbandry.
Dairy Husbandry.
Poultry Husbandry.
Horticulture.
Economic Entomology.
Floriculture and Landscape Gardening.
Rural Engineering.
Laboratory Manuals in Agriculture.
General Science.
Agricultural Science.

Write also to the last above address for lists of bulletins and volumes of the U. S. Department of Agriculture classified for the use of teachers. The lists are issued on a number of topics:

Agronomy.
Animal Husbandry.
Dairying.
Birds and Other Animals.
Horticulture.
Gardening.
Rural Engineering.
Farm Management.
Home Economics.

LISTS OF AIDS IN TEACHING AGRICULTURE

Send to the Division of Agricultural Instruction, States Relations Service, U. S. Department of Agriculture, Washington, D. C., for a list of each of the following:

"Sources of Pictures Useful in Teaching Agriculture and Nature Study."
"Sources of Maps, Charts, and Models."
"Lists of Exhibits."
Dealers in "Laboratory Equipment and Supplies."
Bulletins and circulars on "Suggestions for Teachers in Secondary Schools."
Sources of Projection Apparatus and Materials: Lantern slides available from private firms; moving picture films; projection apparatus.
Lantern Slides with syllabi.
List of Illustrated Lectures.

Write to the teacher-training institutions of your state, particularly those officially designated, as the Agricultural College, for the following things. Some of these may best be obtained from your state supervisor, whose office is probably at the state capital.

List of slides and charts and films and exchanges for these.
Project work blanks.
Farm account blank books.
Samples of illustrative material.
List of firms that furnish samples and illustrative material.
List of Livestock Breeders' Associations.
Lists of Agricultural Journals recommended for the State.
State course of study and list of book adoptions.
State Library regulations and blanks.
Detailed outlines of lessons and exercises in various subjects.
Lists of apparatus for equipping schools.
Project outlines.
Pamphlets issued by the Federal Board for Vocational Education.
Extension bulletins, farmers' bulletins, club bulletins.

THE AGRICULTURAL EXPERIMENT STATIONS

Alabama.—College Station, Auburn; Canebrake Station, Uniontown; Tuskegee Station, Tuskegee Institute.
Alaska.—Sitka.
Arizona.—Tucson.
Arkansas.—Fayetteville.
California.—Berkeley.
Colorado.—Fort Collins.
Connecticut.—State Station, New Haven; Storrs Station, Storrs.
Delaware.—Newark.
Florida.—Gainesville.
Georgia.—Experiment.
Guam.—Island of Guam.
Hawaii.—Federal Station, Honolulu; Sugar Planters' Station, Honolulu.
Idaho.—Moscow.
Illinois.—Urbana.
Indiana.—Lafayette.
Iowa.—Ames.
Kansas.—Manhattan.
Kentucky.—Lexington.
Louisiana.—State Station, Baton Rouge; Sugar Station, Audubon Park, New Orleans; North La. Station, Calhoun; Rice Station, Crowley.
Maine.—Orono.
Maryland.—College Park.
Massachusetts.—Amherst.
Michigan.—East Lansing.
Minnesota.—University Farm, St. Paul.
Mississippi.—Agricultural College.
Missouri.—College Station, Columbia; Fruit Station, Mountain Grove.
Montana.—Bozeman.
Nebraska.—Lincoln.
Nevada.—Reno.
New Hampshire.—Durham.

THE AGRICULTURAL EXPERIMENT STATIONS (Continued):

New Jersey.—New Brunswick
New Mexico.—State College.
New York.—State Station, Geneva; Cornell Station, Ithaca.
North Carolina.—Raleigh and West Raleigh.
North Dakota.—Agricultural College.
Ohio.—Wooster.
Oklahoma.—Stillwater.
Oregon.—Corvallis.
Pennsylvania.—State College.
Porto Rico.—Federal Station, Mayaguez; Insular Station, Rio Piedras.
Rhode Island.—Kingston.
South Carolina.—Clemson College.
South Dakota.—Brookings.
Tennessee.—Knoxville.
Texas.—College Station.
Utah.—Logan.
Vermont.—Burlington.
Virginia.—Blacksburg; Truck Station, Norfolk.
Virgin Islands.—St. Croix.
Washington.—Pullman.
West Virginia.—Morgantown.
Wisconsin.—Madison.
Wyoming.—Laramie.

AMERICAN LIVESTOCK RECORD ASSOCIATIONS

Every school teaching agriculture should write to the secretary of the associations of those breeds of livestock of importance in the region. Ask for pamphlets and other literature regarding the particular breed, and also for blanks used in registering animals. Some of the associations can furnish fine pictures of noted animals of their breeds. These may be mounted on wall cards, as framed, or used in making charts. Some of them can supply charts. A few of the associations have sets of lantern slides or films to loan to schools.

Get a revised list of these associations and also a list of state and county livestock associations by writing to the animal husbandry department of your State Agricultural College.

Horses

Arabian Horse Club of Am., 1729 "G" Street N. W., Washington, D. C.
Am. Assn. of Importers and Breeders of Belgian Draft Horses, Wabash, Ind.
Cleveland Bay Society of Am., Oconomowoc, Wis.
Am. Clydesdale Assn., Union Stock Yards, Chicago.
French Coach Horse Society of Am., Oak Park, Ill.
National French Draft Horse Assn. of Am., Fairfield, Iowa.
German, Hanoverian and Oldenburg Coach Horse Assn. of Am., Lafayette, Ind.
Am. Hackney Horse Soc., Hempstead, L. I., N. Y.
Am. Morgan Register Assn., Middlebury, Vt.
Percheron Society of Am., Union Stock Yards, Chicago.
Am. Breeders' and Importers' Percheron Registry Co., Plainfield, Ohio.
Am. Saddle Horse Breeders' Assn., Lawrenceburg, Ky.
Am. Shetland Pony Club, Lafayette, Ind.
Am. Shire Horse Assn., Wenona, Ill.
Am. Suffolk Horse Assn., DeKalb, Ill.
Am. Trotting Register Assn., 137 South Ashland Ave., Chicago.
Jockey Club, 6–8 East 46th Street, New York, N. Y.
Welsh Pony and Cob Society of Am., Lafayette, Ind.

Jacks and Jennets

Am. Breeders' Assn. of Jacks and Jennets, Columbia, Tenn.
Standard Jack and Jennet Registry of Am., Kansas City, Mo.

Cattle

Am. Aberdeen-Angus Breeders' Assn., Union Stock Yards, Chicago.
Ayrshire Breeders' Assn., Brandon, Vt.
Brown Swiss Cattle Breeders' Assn., Beloit, Wis.
Am. Devon Cattle Club, Charlottesville, Va.
Dutch Belted Cattle Assn. of Am., Marksboro, N. J.
American Galloway Breeders' Assn., Independence, Mo.
Am. Guernsey Cattle Club, Peterboro, N. H.
American Hereford Cattle Breeders' Assn., Kansas City, Mo.
Holstein-Friesian Assn. of Am., Brattleboro, Vt.
Am. Jersey Cattle Club, 324 West 23d Street, New York, N. Y.
Am. Kerry and Dexter Cattle Club, Columbus, Ohio.
Polled Durham Breeders' Assn., Greenville, Ohio.
Am. Polled Hereford Breeders' Assn., Des Moines, Iowa.
Red Polled Cattle Club of Am., Gotham, Wis.
Am. Shorthorn Breeders' Assn., Union Stock Yards, Chicago.
Am. Dairy Shorthorn Cattle Club, Orangeville, Ohio.
Am. Polled Durham Breeders' Assn., Indianapolis, Ind.

Sheep

Am. Cheviot Sheep Society, Fayetteville, N. Y.
Am. Cotswold Registry Assn., Waukesha, Wis.
Continental Dorset Club, Mechanicsburg, Ohio.
Am. Hampshire Sheep Assn., Coldwater, Mich.
Am. Leicester Breeders' Assn., Cameron, Ill.
National Lincoln Sheep Breeders' Assn., Charlotte, Mich.
Am. and Delaine Merino Record Assn., Delaware, Ohio.
Dickinson Merino Sheep Record Co., New Berlin, Ohio.
National Delaine Merino Sheep Breeders' Assn. of Washington County, Canonsburg, Pa.
Standard Delaine Merino Sheep Breeders' Assn., Saline, Mich.
Am. Rambouillet Sheep Breeders' Assn., Milford Center, Ohio.
International Von Homeyer Rambouillet Club, Ann Arbor, Mich.
Michigan Merino Sheep Breeders' Assn., Ann Arbor, Mich.
Vermont, New York and Ohio Merino Sheep Breeders' Assn., Delaware, Ohio.
Am. Oxford Down Record Assn., Hamilton, Ohio.
Am. Romney Breeders' Assn., Mechanicsburg, Ohio.
Am. Shropshire Registry Assn., Lafayette, Ind.
Am. Southdown Breeders' Assn., Springfield, Ill.
Am. Tunis Sheep Breeders' Assn., Crawfordsville, Ind.

Goats

Am. Angora Goat Breeders' Assn., Lawrence, Kans.
Am. Milch Goat Record Assn., Dean, Ohio.

Hogs

Am. Berkshire Assn., Springfield, Ill.
Am. Large Black Pig Soc., Lexington, Ky.
Cheshire Swine Breeders' Assn., Freeville, N. Y.
O. I. C. Swine Breeders' Assn., P. O. Drawer "U," Cleveland, Ohio.
Chester White Record Assn., Rochester, Ind.
Am. Duroc Jersey Swine Breeders' Assn., Union Stock Yards, Chicago.
National Duroc Jersey Record Assn., Peoria, Ill.
Am. Hampshire Swine Record Assn., Peoria, Ill.
Am. Poland China Record Co., Union Stock Yards, Chicago.
National Poland China Record Co., Winchester, Ind.
Standard Poland China Record Assn., Maryville, Mo.
Am. Tamworth Swine Record Assn., Ann Arbor, Mich.
Am. Yorkshire Club, White Bear Lake, Minn.
National Mule-foot Hog Assn., Ada, Ohio.
Mule-foot Hog Breeders' Assn., Mammoth Springs, Ark.
Am. Mule-foot Hog Record Co., Columbus, Ohio.

HOW TO MAKE LANTERN SLIDES BY HAND

(J. V. Ankeney)

It is often advisable to make lantern slides by hand in order to quickly present tables, diagrams, cartoons, announcements, songs, etc. The following are some methods which have been used by the writer and have been useful.

Ink on Glass.—1. Clean a glass slide and with a crow quill pen write, print, or draw on the glass with India ink. The ink will take more readily if the dry finger is first rubbed over the spot on which the lettering is to be done.

2. Special inks in a variety of colors known as lantern slide inks may be purchased. These may be used with clean pen on the slide.

3. One may write directly on ground glass or mica with either pen or pencil. Mica slides withstand the heat.

Ink or Pencil on Prepared Glass.—1. An ordinary unexposed lantern slide plate may be fixed in the usual way, washed, and allowed to dry, after which it may be written on with either pencil or pen. This, of course, is rather costly.

2. A 10 per cent solution of gelatin in hot water may be made and flowed over the glass side, allowed to dry, and be written on as above.

3. A solution of Canada balsam in either turpentine or xylol (xylol dries quicker) flowed over a glass slide is more satisfactory than the gelatin solution.

4. A ground glass substitute is made as follows: Sandarac, 90 gr.; mastic, 20 gr.; ether, 2 oz.; benzole, $\frac{1}{2}$ to $1\frac{1}{2}$ oz. The proportion of the benzole added determines the grain of the matt obtained; this may be flowed over the glass slide. This dries in a few minutes (2 or 3), leaves a matt surface which softens the projected light, and takes ink and pencil well.

On Gelatin Sheets.—1. Sheet gelatin may be purchased in a variety of colors, also clear and matt. This will take ink, pencil (on matt), and typewriter. For best results on a typewriter place two pieces of new carbon paper so that their faces touch the gelatin sheet. Type in the usual way and place between cover glasses with vignette matt and bind.

2. In order to make the above idea more easily carried out several companies now make a combination gelatin sheet, carbon paper, and matt ready to go into the typewriter. The gelatin sheet is mounted in the usual way.

Miscellaneous.—The simplest slide to make is that made by smoking a glass slide over a candle or kerosene lamp and scratching the letters or drawing with a pin or other sharp instrument.

A glass pencil or china marker's pencil may be procured from any laboratory supply house or from most stationers. This may be used for writing on glass direct.

The value of the above suggestions will depend upon the ingenuity of the user and the care exercised in executing them.

HOW TO MAKE A HECTOGRAPH

(J. V. Ankeney)

Clay Hectograph.—1. Get a shallow pan (about 1 inch deep) of a size slightly larger than the sheet of paper which you wish to use.

2. Fill this carefully with modeling clay or plastacine, pounding and working into place with a straight-edge. When the surface is perfectly smooth add glycerine slowly until it will absorb no more. Allow to stand until all glycerine is absorbed.

3. To use, write with aniline ink or duplicator typewriter ribbon on a good grade of bond paper. Lay a plain sheet of paper on the pad and rub it smooth with a round stick or squeegee roller. This is to level the surface and make it smooth. Now place the prepared copy face down on the hectograph and rub into perfect contact. Remove in from 3 to 5 minutes. Then proceed by placing clean sheets one at a time on the pad and rubbing into contact. The length of time necessary to secure a perfect copy may be found by experiments.

4. Keep a cloth moistened with glycerine over the pad when not in use.

5. A piece of glass or a metal lid may serve as a cover to the box.

6. To use again, wash off the surface with a moist sponge until clean. Dry with a rag and proceed as above.

Gelatin Hectograph.—1. Secure a pan a little larger than the sheet you wish to use. This may be a cake or bread pan or may be made of wood.

2. Soak 2 oz. of gelatin in water over night. The surplus water should be poured off. Twelve or thirteen ounces of glycerine should be heated to about the boiling point of water, add the gelatin. Pour into the pan and prick all air bubbles. Let stand in a cool place until perfectly firm. Be sure pan is level and kept covered.

3. Make the copy as suggested above. Moisten surface slightly and proceed as above. When through using the hectograph, wash the surface with a moist sponge. A few drops of oil of cloves added to gelatin acts as a preservative during hot weather.

Note.—Hectograph ink may be purchased from stationers and school-supply houses.

PREPARATION FOR LABORATORY TABLE TOPS

Here is a recipe for an inexpensive method of treating the tops of wooden laboratory tables. Slate is costly. Glass is easily broken. Paint is eaten off by acids. Two solutions are used. The first is composed of 50 grams of copper sulfate and 50 grams of potassium chlorate, the two being boiled in 400 grams of water. This first solution is put on with a large brush while boiling hot. The wood must be clean and free from oil or paint so the solution will penetrate the surface. Apply a second coat when dry.

The second solution is made by dissolving 60 grams of anilin oil in 80 grams of concentrated hydrochloric acid and diluting this to 500 grams with water. Apply one coat of this. After drying, the two solutions may each be applied again if a darker color is desired. Wash the top later with hot soap suds and when dry rub in a little melted paraffin mixed with vaseline. This recipe is enough for three or more tables such as are described in Chapter XV.

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